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NEW CHAPTERS IN THE WARFARE OF SCIENCE.

VII. COMPARATIVE MYTHOLOGY.

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PART I.

A FEW years since, Maxime Du Camp, an eminent member of the French Academy, traveling from the Red Sea to the Nile through the Desert of Kosseir, came to a barren slope covered with bowlders, rounded and glossy.

His Mohammedan camel-drivers accounted for them on this wise:

"Many years ago Hadji Abdul-Aziz, a sheik of the dervishes, was traveling on foot through this desert; it was summer; the sun was hot and the dust stifling; thirst parched his lips, fatigue weighed down his back, sweat dropped from his forehead, when looking up he saw—on this very spot—a garden beautifully green, full of fruit, and, in the midst of it, the gardener.

"'O fellow-man,' cried Hadji Abdul-Aziz, 'in the name of Allah, clement and merciful, give me a melon and I will give you my prayers.'

"The gardener answered, 'I care not for your prayers; give me money, and I will give you fruit.'

"'But,' said the dervish, 'I am a beggar; I have never had money; I am thirsty and weary, and one of your melons is all that I need.'

"'No,' said the gardener, 'go to the Nile and quench your thirst.'

"Thereupon the dervish, lifting his eyes toward heaven, made this prayer: 'O Allah, thou who in the midst of the desert didst make the fountain of Zem-Zem spring forth to satisfy the thirst

of Ismail, father of the faithful; wilt thou suffer one of thy creatures to perish thus of thirst and fatigue?'

"And it came to pass that, hardly had the dervish spoken, when an abundant dew descended upon him, quenching his thirst and refreshing him even to the marrow of his bones.

"Now at the sight of this miracle the gardener knew that the dervish was a holy man, beloved of Allah, and straightway offered him a melon.

"'Not so,' answered Hadji Abdul-Aziz, 'keep what thou hast, thou wicked man. May thy melons become as hard as thy heart, and thy field as barren as thy soul!'

"And straightway it came to pass that the melons were changed into these blocks of stone, and the grass into this sand, and never since has anything grown thereon."

In this story, and in myriads like it, we have a survival of that early conception of the universe in which so many of the leading moral and religious truths of the great sacred books of the world are imbedded.

All ancient sacred lore abounds in such mythical explanations of remarkable appearances in nature, and these are most frequently prompted by mountains, rocks, and bowlders seemingly misplaced.

In India we have such typical examples among the Brahmans as the mountain-peak which Durgu threw at Parvati; and among the Buddhists the stone which Devadatti hurled at Buddha.

In Greece the Athenian, rejoicing in his belief that Athena guarded her chosen people, found it hard to understand why the great rock Lycabettus should be just too far from the Acropolis to be of use as an outwork; but a myth was developed which explained all. According to this, Athena had intended to make Lycabettus a defense for the Athenians, and she was bringing it through the air from Pallene for that very purpose; but, unfortunately, a raven met her and informed her of the wonderful birth of Erichthonius, which so surprised the goddess that she dropped the rock where it now stands.

So, too, a peculiar rock at Ægina was accounted for by a long and circumstantial legend to the effect that Peleus threw it at Phocas.

A similar mode of explaining such objects is seen in the mythologies of northern Europe. In Scandinavia we constantly find rocks which tradition accounts for by declaring that they were hurled by the old gods at each other, or at the early Christian churches.

In Teutonic lands, as a rule, wherever a strange rock or stone is found, there will be found a myth or a legend, heathen or Christian, to account for it.

So, too, in Celtic countries; typical of this mode of thought in Brittany and in Ireland is the popular belief that such features in the landscape were dropped by the devil or by fairies.

Even at a much later period such myths have grown and bloomed; Marco Polo gives a long and circumstantial legend of a mountain in Asia Minor which, not long before his visit, was removed by a Christian who had "faith as a grain of mustard-seed," and, remembering the Saviour's promise, transferred the mountain to its present place by prayer, "at which marvel many Saracens became Christians."*

Similar mythical explanations are also found, in all the older religions of the world, for curiously marked meteoric stones, fossils, and the like.

Typical examples are found in the imprint of Buddha's feet on stones in Siam and Ceylon; in the imprint of the body of Moses, which down to the middle of the last century was shown near Mount Sinai; in the imprint of Poseidon's trident on the Acropolis at Athens; in the imprint of the hands or feet of Christ on stones in France, Italy, and Palestine; in the imprint of the Virgin's tears on stones at Jerusalem; in the imprint of the feet of Abraham at Jerusalem and of Mohammed on a stone in the Mosque of Khait Bey at Cairo; in the imprint of the fingers of giants on stones in the Scandinavian Peninsula, in north Germany, and in western France; in the imprint of the devil's thighs on a rock in Brittany, and of his claws on stones which he threw at churches in Cologne and Saint Pol-de-Léon; in the imprint of the shoulder of the devil's grandmother on the "elbow-stone" at the Mohrinersee; in the imprint of St. Otho's feet on a stone formerly preserved in the castle church at Stettin; in the imprint of the little finger of Christ and the head of Satan at Ehrenberg; and in the imprint of the feet of St. Agatha at Catania, in Sicily. To account for these appearances and myriads of others, long and interesting legends were developed, and out of this mass we may take one or two as typical.

* For Maxime Du Camp, see "Le Nil, Egypte et Nubie," Paris, 1877, chapter v. For India, see Düncker, "Geschichte des Alterthums," iii, 366; also Coleman, "Mythology of the Hindus," p. 90. For Greece, as to the Lycabettus myth, see Leake, "Topography of Athens," vol. i, sec. 3; also Burnouf, "La Légende Athénienne," p. 152. For the rock at Ægina, see Charton, vol. i, p. 310. For Scandinavia, see Thorpe, "Northern Antiquities," *passim*. For Teutonic countries, see Grimm, "Deutsche Mythologie"; Panzer, "Beitrag zur deutschen Mythologie," vol. ii; and especially J. B. Friedrich, "Symbolik und Mythologie der Natur," pp. 116 *et seq.* For Celtic examples I am indebted to that learned and genial scholar, Prof. J. P. Mahaffy, of Trinity College, Dublin. See also story of the devil dropping a rock when forced by the archangel Michael to aid him in building Mont Saint-Michel on the west coast of France, in Sébillot's "Traditions de la Haute-Bretagne," vol. i, p. 22; also multitudes of other examples in the same work. For Marco Polo, see in Grynæus, p. 337; also Charton, "Voyageurs anciens et modernes," pp. 274 *et seq.*, where the long and circumstantial legend is given.

One of the most beautiful was evolved at Rome. On the border of the mediæval city stands the church of "Domine quo vadis"; it was erected in honor of a stone, which is still preserved, bearing a mark resembling a human footprint—perhaps the bed of a fossil.

Out of this a pious legend grew as naturally as a wild rose in a prairie. According to this story, in one of the first great persecutions the heart of St. Peter failed him, and he attempted to flee from the city; arriving outside the walls he was suddenly confronted by the Master, whereupon Peter in amazement asked, "Lord, where goest thou?" (*Domine quo vadis?*); to which the Master answered, "To Rome, to be crucified again." The apostle, thus rebuked, returned to martyrdom; the Master vanished, but left, as a perpetual memorial, his footprint in the solid rock.

Still another legend accounts for a curious mark in a stone at Jerusalem. According to this, St. Thomas, after the ascension of the Lord, was again troubled with doubts, whereupon the Virgin Mother threw down her girdle, which left its imprint upon the rock, and thus converted the doubter fully and finally.

And still another example is seen at the very opposite extreme of Europe, in the legend of the priestess of Hertha in the island of Rugen. She had been unfaithful to her vows, and the gods furnished a proof of her guilt by causing her and her child to sink into the rock on which she stood.*

* For myths and legends crystallizing about bowlders and other stones curiously shaped or marked, see, on the general subject, in addition to works already cited, Des Brosses, "Les Dieux Fétiches," 1760, *passim*, but especially pp. 166, 167; and for a condensed statement as to worship paid them, see Gerard de Rialle, "Mythologie comparée," vol. vi, chapter ii. For imprints of Buddha's feet, see Tylor, "Researches into the Early History of Mankind," London, 1878, pp. 115 *et seq.*; also Coleman, p. 203, and Charton, "Voyageurs anciens et modernes," pp. 365, 366, where engravings of one of the imprints, and of the temple above another, are seen. There are five which are considered authentic by the Siamese, and a multitude of others more or less strongly insisted upon. For the imprint of Moses' body, see travelers from Sir John Maundeville down. For the mark of Neptune's trident, see last edition of Murray's "Handbook of Greece," vol. i, p. 322; and Burnouf, "La Légende Athénienne," p. 153. For imprint of the feet of Christ, and the Virgin's girdle and tears, see many of the older travelers in Palestine, as Arculf, Bouchard, Roger, and especially Bertrandon de la Brocquière in Wright's "Collection," pp. 339, 340; also Maundrell's "Travels" and Maundeville. For the curious legend regarding the imprint of Abraham's foot, see Weil, "Biblische Legenden der Muselmänner," pp. 91 *et seq.* For many additional examples in Palestine, particularly the imprints of the bodies of three apostles on stones in the Garden of Gethsemane and of St. Jerome's body in the desert, see Beauvau, "Rélation du Voyage du Levant," Nancy, 1615, *passim*. For the various imprints made by Satan and giants in Scandinavia and Germany, see Thorpe, ii, 85; Friedrichs, pp. 126 and *passim*. For a very rich collection of such explanatory legends regarding stones and marks in Germany, see Karl Bartsch, "Sagen, Märchen und Gebräuche aus Mecklenburg," Wien, 1880, vol. ii, pp. 420 *et seq.* For a woodcut representing the imprint of St. Agatha's feet at Catania, see Charton, "Voyageurs anciens et modernes," vol. ii, p. 75. For a woodcut representing the imprint of Christ's feet on the stone from which he ascended to heaven, see woodcut in Maundeville, edition of 1484, in the White Library,

Another and very fruitful source of explanatory myths is found in ancient centers of volcanic action, and especially in old craters of volcanoes and fissures filled with water.

In China we have, among other examples, Lake Man, which was once the site of the flourishing city Chiang Shui, overwhelmed and sunk on account of the heedlessness of its inhabitants regarding a divine warning.

In Phrygia the lake and morass near Tyana were ascribed to the wrath of Zeus and Hermes, who, having visited the cities which formerly stood there, and having been refused shelter by all the inhabitants save Philemon and Baucis, sank the wicked cities beneath the lake and morass, but rewarded their benefactors.

Stories of similar import grew up to explain the crater near Sipylos in Asia Minor and that of Avernus in Italy; the latter came to be considered the mouth of the infernal regions, as every school-boy knows when he has read his Virgil.

In the later Christian mythologies we have such typical legends as those which grew up about the old crater in Ceylon; the salt water in it was accounted for by supposing it the tears of Adam and Eve, who retreated to this point after their expulsion from paradise and bewailed their sin during a hundred years.

So, too, in Germany we have multitudes of lakes supposed to owe their origin to the sinking of valleys as a punishment for human sin. Of these are the "Devil's Lake," near Güstrow, which rose and covered a church and its priests on account of their corruption; the lake at Probst-Jesar, which rose and covered an oak-grove and a number of peasants resting in it on account of their want of charity to beggars; and the Lucin Lake, which rose and covered a number of soldiers on account of their cruelty to a poor peasant.

Such legends are found throughout America and in Japan, and will doubtless be found throughout Asia and Africa, and especially among the volcanic lakes of South America, the pitch lakes of the Caribbean Islands, and even about the Salt Lake of Utah; for explanatory myths and legends under such circumstances are inevitable.*

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* As to myths explaining volcanic craters and lakes, and embodying ideas of the wrath of Heaven against former inhabitants of the neighboring country, see Forbiger, "Alte Geographie," Hamburg, 1877, i, 563. For exaggerations concerning the Dead Sea, see ibid., i, 575. For the sinking of Chiang Shui and other examples, see Denny's "Folklore of China," p. 126 *et seq.* For the sinking of the Phrygian region, the destruction of its inhabi-

To the same manner of explaining striking appearances in physical geography, and especially strange rocks and bowlders, we mainly owe the innumerable stories of the transformation of living beings, and especially of men and women, into these natural features.

In the mythology of China we constantly come upon legends of such transformations—from that of the first counselor of the Han dynasty to those of shepherds and sheep. In the Brahmanical mythology of India, Salagrama, the fossil ammonite, is recognized as containing the body of Vishnu's wife, and the Binlang stone has much the same relation to Siva; so, too, the nymph Ramba was changed, for offending Ketu, into a mass of sand; by the breath of Siva elephants were turned into stone, and in a very touching myth Luxman is changed into stone but afterward released. In the Buddhist mythology a Nat demon is represented as changing himself into a grain of sand.

Among the Greeks such transformation-myths come constantly before us—both the changing of stones to men and the changing of men to stones. Deucalion and Pyrrha, escaping from the flood, repeopled the earth by casting behind them stones which became men and women; Heraulos was changed into stone for offending Mercury; Pyrrhus for offending Rhea; Phineus, and Polydektes with his guests, for offending Perseus; under the petrifying glance of Medusa's head such transformations became a thing of course.

To myth-making in obedience to the desire of explaining striking natural appearances, coupled with the idea that sin must be followed by retribution, we also owe the well-known Niobe myth. Having incurred the divine wrath, she saw those dearest to her destroyed by missiles from heaven, and was finally transformed into a rock on Mount Sipylos which bore some vague resemblance to the human form, and her tears became the rivulets which trickled from the neighboring strata.

Thus, in obedience to a moral and intellectual impulse, a striking geographical appearance was explained, and for ages pious Greeks looked with bated breath upon the rock at Sipylos which was once Niobe, just as for ages pious Jews, Christians, and Mohammedans looked with awe upon the salt pillar at the Dead Sea which was once Lot's wife.

tants, and the saving of Philemon and Baucis, see Ovid's "Metamorphoses," Book VIII; also Bötticher, "Baumcultus der Alten," etc. For the lake in Ceylon arising from the tears of Adam and Eve, see variants of the original legend in Maundeville and in Jürgen Andersen, "Reisebeschreibung," 1669, ii, 132. For the volcanic nature of the Dead Sea, see Daubeny cited in Smith's "Dictionary," 1873, *sub voc.* "Palestine." For lakes in Germany owing their origin to human sin and various supernatural causes, see Karl Bartsch, "Sagen, Märchen und Gebräuche aus Mecklenburg," vol. i, pp. 397 *et seq.* For lakes in America, see any good collection of Indian legends. For lakes in Japan sunk supernaturally, see Braun's "Japanesische Märchen und Sagen," Leipsic, 1885, pp. 350, 351.

Pausanias, one of the most honest of ancient travelers, gives us a striking exhibition of this feeling. Having visited this monument of divine vengeance at Mount Sipylos, he tells us very naïvely that, though he could discern no human features when standing near it, he thought that he could see them when standing at a distance. There could hardly be a better example of that most common and deceptive of all things—belief created by the desire to believe.

In the pagan mythology of Scandinavia we have such typical examples as Börs slaying the giant Ymir and transforming his bones into bowlders; also "the giant who had no heart" transforming six brothers and their wives into stone; and, in the old Christian mythology, St. Olaf changing into stone the wicked giants who opposed his preaching.

So, too, in Celtic countries we have in Ireland such legends as those of the dancers turned into stone; and in Brittany, the stones at Plessé, which were once hunters and dogs violating the sanctity of Sunday; and the stones of Carnac, which were once soldiers who sought to kill St. Cornely.

Teutonic mythology inherited from its earlier Eastern days a similar mass of old legends, and developed a still greater mass of new ones. Thus, near the Königstein, which all visitors to the Saxon Switzerland know so well, is a bowlder which for ages was believed to have once been a maiden transformed into stone for refusing to go to church; and near Rosenberg in Mecklenburg is another curiously shaped stone of which a similar story is told. Near Spornitz, in the same region, are seven bowlders whose forms and position are accounted for by a long and circumstantial legend that they were once seven impious herdsmen; near Brahlsdorf is a stone which, according to a similar explanatory myth, was once a blasphemous shepherd; near Schwerin are three bowlders which were once wasteful servants; and at Neustadt, down to a recent period, was shown a collection of stones which were once a bride and bridegroom with their horses and wagon—all punished for an act of cruelty; and these stories are but typical of thousands.

At the other extremity of Europe we may take, out of the multitude of explanatory myths, that which grew about the well-known group of bowlders near Belgrade. In the midst of them stands one larger than the rest: according to the legend which was developed to account for all these, there once lived there a swineherd, who was disrespectful to the consecrated host; whereupon he was changed into the larger stone, and his swine into the smaller ones. So also at Saloniki we have the pillars of the ruined temple, which are widely believed, especially among the Jews of that region, to have once been human beings, and are therefore known as the "enchanted columns."

Among the Arabs we have an addition to our sacred account of Adam—the legend of the black stone of the Caaba at Mecca, into which the angel was changed who was charged by the Almighty to keep Adam away from the forbidden fruit, and who neglected his duty.

Similar old transformation legends are abundant among the Indians of America, the negroes of Africa, and the natives of Australia and the Pacific islands.

Nor has this making of myths to account for remarkable appearances yet ceased, even in civilized countries.

About the beginning of this century the Grand Duke of Weimar, smitten with the classical mania of his time, placed in the public park near his palace a little altar, and upon this was carved, after the manner so frequent in classical antiquity, a serpent taking a cake from it.

And shortly there appeared, in the town and the country around about, a legend to explain this altar and its decoration. It was commonly said that a huge serpent had laid waste that region in the olden time, until a wise and benevolent baker had rid the world of the monster by means of a poisoned biscuit.

So, too, but a few years since, in the heart of the State of New York, a swindler of genius having made and buried a "petrified giant," one theologian explained it by declaring it a Phœnician idol, and published the Phœnician inscription which he thought he had found upon it; others saw in it proofs that "there were giants in those days," and within a week after its discovery myths were afloat that the neighboring remnant of the Onondaga Indians had traditions of giants who frequently roamed through that region.*

* For transformation myths and legends, identifying rocks and stones with gods and heroes, see Welcker, "Götterlehre," pp. 218 *et seq.* For recent and more accessible statements for the general reader, see Robertson Smith's admirable "Lectures on the Religion of the Semites," Edinburgh, 1889, pp. 86 *et seq.* For some thoughtful remarks on the ancient adoration of stones rather than statues, with reference to the anointing of the stones at Bethel by Jacob, see Dodwell, "Tour through Greece," vol. ii, p. 172; also Robertson Smith as above, Lecture V. For Chinese transformation legends, see Denny's "Folklore of China," pp. 96 and 128. For Hindu and other ancient legends of transformations, see Dawson, "Dictionary of Hindu Mythology," also Coleman as above, also Cox, "Mythology of the Aryan Nations," pp. 81–97, etc. For such transformations in Greece, see the "Iliad," and Ovid as above; also Stark, "Niobe und die Niobiden," p. 444 and elsewhere; also Preller, "Griechische Mythologie," ii, 383; also Baumeister, "Denkmäler des classischen Alterthums," Art. "Niobe"; also Bötticher as above; also Curtius, "Griechische Geschichte," vol. i, pp. 71, 72. For Pausanius's *naïve* confession regarding the Sipylos rock, see Book I, 215. See also Texier, "Asie Mineure," pp. 265 *et seq.*; also Chandler, "Travels in Greece," vol. ii, p. 80, who seems to hold to the later origin of the statue. At the end of Baumeister there is an engraving copied from Stuart which seems to show that, as to the Niobe legend, at a later period Art was allowed to help Nature. For the general subject, see Scheiffle, "Program des K. Gymnasiums," in Ellwangen, "Mythologische Parallelen," 1865. For Scandinavian and Teutonic transformation legends, see Grimm, "Deutsche Mythologie," vierte Ausg., i,

To the same stage of thought belongs the conception of human beings changed into trees.

But, in the historic evolution of religion and morality, while changes into stone or rock were considered as punishment, or evidence of divine wrath, those into trees and shrubs were frequently looked upon as rewards, or evidences of divine favor.

A very beautiful and touching form of this conception is seen in such myths as the change of Philemon into the oak, and of Baucis into the linden; of Myrrha into the myrtle; of Melos into the apple-tree; of Attys into the pine; of Adonis into the rose-tree; and in the springing of the vine and grape from the blood of the Titans, the violet from the blood of Attys, and the hyacinth from the blood of Hyacinthus.

Thus it was, during the long ages when mankind saw everywhere miracle and nowhere law, that, in the evolution of religion and morality, striking features in physical geography became connected with the idea of divine retribution.*

But, in the natural course of intellectual growth, thinking men began to doubt the historical accuracy of these myths and legends —or, at least, to doubt all save those of the theology in which they happened to be born; and the next step was taken when they began to make comparisons between the myths and legends of different neighborhoods and countries; so came into being the science

457; also Thorpe, "Northern Antiquities"; also Friedrich, *passim*, especially p. 116 *et seq.*; also, for a mass of very curious ones, Karl Bartsch, "Sagen, Märchen und Gebräuche aus Mecklenburg," vol. i, p 420, *et seq.*; also Karl Simrock's edition of the "Edda," ninth edition, p. 319; also John Fiske, "Myths and Myth-Makers," pp. 8 and 9. On the universality of such legends and myths, see Ritter's "Erdkunde," xiv, 1098–1122. For Irish examples, see Manz, "Real Encyclopädie," art. "Stein"; and for multitudes of examples in Brittany, see Sébillot, "Traditions de la Haute-Bretagne." For the enchanted columns at Saloniki, see latest edition of Murray's "Handbook of Turkey," vol. ii, p. 711. For the legend of the angel changed into stone for neglecting to guard Adam, see Weil, university librarian at Heidelberg, "Biblische Legende der Muselmänner," Frankfort-am-Main, 1845, pp. 37 and 84. For similar transformation legends in Australia and among the American Indians, see Andrew Lang, "Mythology," French translation, pp. 83 and 102; also his "Myth Ritual and Religion," vol. i, pp. 150 *et seq.*, citing numerous examples from J. G. Müller, "Urreligionen," Dorman's "Primitive Superstitions," and "Report of the Bureau of Ethnology" for 1880–'81; and for an African example, see account of the rock at Balon which was once a woman, in Bérenger-Feraud, "Contes populaires de la Sénégambie," chap. viii. For the Weimar legend, see Lewes, "Life of Goethe," Book IV. For the myths which arose about the swindling "Cardiff Giant" in the State of New York, see especially an article by G. A. Stockwell, M. D., in "The Popular Science Monthly" for June, 1878; and for the "Phœnician inscription," given at length with a translation, see the Rev. Alexander McWhorter, in "The Galaxy" for July, 1872. The present writer has in his possession a mass of curious documents regarding this fraud and the myths to which it gave rise, and hopes ere long to prepare a supplement to Dr. Stockwell's valuable paper.

* For the view taken in Greece and Rome of transformations into trees and shrubs, see Böttticher, "Baumcultus der Alten," xix, pp. 2 and 3; also Ovid, "Metamorphoses," *passim*; also foregoing notes.

of Comparative Mythology—a science sure to be of vast value, because, despite many stumblings and vagaries, it shows ever more and more how our religion and morality have been gradually evolved, and gives a firm basis to faith that higher planes may yet be reached.

Such a science makes the sacred books of the world more and more precious, in that it shows how they have been the necessary envelopes of our highest spiritual sustenance; how even myths and legends apparently the most puerile have been the natural husks and rinds and shells of our best ideas; and how the atmosphere is created in which these husks and rinds and shells in due time wither, shrivel, and fall away, so that the fruit itself may be gathered to sustain a nobler religion and a purer morality.

The coming in of Christianity contributed elements of inestimable value in this evolution, and, at the center of all, the thoughts, words, and life of the Master. But when, in the darkness that followed the downfall of the Roman Empire, there was developed a theology and a vast ecclesiastical power to enforce it, the most interesting chapters in this evolution of religion and morality were unfortunately removed from the domain of science.

So it came that for over eighteen hundred years it has been thought natural and right to study and compare the myths and legends arising east and west and south and north of Palestine with each other, but never with those of Palestine itself; so it came that one of the regions most fruitful in materials for reverent thought and healthful comparison was held exempt from the unbiased search for truth; so it came that, in the name of truth, truth was crippled for ages. While observation, and thought upon observation, and the organized knowledge or science which results from these, progressed as regarded the myths and legends of other countries, and an atmosphere was thus produced giving purer conceptions of the world and its government; myths of that little geographical region at the eastern end of the Mediterranean retained possession of the civilized world in their original crude form, and have at times done much to thwart the noblest efforts of religion, morality, and civilization.

The history of myths—of their growth under the earlier phases of human thought and of their decline under modern thinking—is one of the most interesting and suggestive of human studies; but, since to treat it as a whole would require volumes, I shall select only one small group, and out of this mainly a single myth—one about which there can no longer be any dispute—the group of myths and legends which grew upon the shore of the Dead Sea, and especially that one which grew up to account for the successive salt columns at its southwestern extremity.

The Dead Sea is about thirty-nine geographical miles in

length and nine miles in width; it lies in a very deep fissure extending north and south, and its surface is about thirteen hundred feet below that of the Mediterranean. It has, therefore, no outlet, and is the receptacle for the waters of the whole system to which it belongs, including those collected by the Sea of Galilee and brought down thence by the river Jordan.

It certainly—or, at least, the larger part of it—ranks geologically among the oldest lakes on earth. In a broad sense the region is volcanic: on its shore are evidences of volcanic action which must, from the earliest period, have aroused wonder and fear, and stimulated the myth-making tendency to account for them. On the eastern side are impressive mountain-masses which have been thrown up from old volcanic vents; mineral and hot springs abound, some of them spreading sulphurous odors; earthquakes have been frequent, and from time to time these cast up masses of bitumen; concretions of sulphur and large formations of salt constantly appear.

The water which comes from the springs or oozes through the salt layers upon its shores constantly brings in various salts in solution, and, being rapidly evaporated under the hot sun and dry wind, there has been left, in the bed of the lake, a strong brine heavily charged with the usual chlorides and bromides—a sort of bitter "mother liquor." This fluid has become so dense as to have a remarkable power of supporting the human body; is of an acrid and nauseating bitterness; and by ordinary eyes no evidence of life is seen in it.

Thus it was that in the lake itself, and in its surrounding shores, there was enough to make the generation of explanatory myths on a large scale inevitable.

The main northern part of the lake is very deep, the plummet having shown an abyss of thirteen hundred feet, but the southern end is shallow and in places marshy.

The system of which it forms a part shows a likeness to that in South America, of which the mountain lake Titicaca is the main feature; as a receptacle for surplus waters, only rendering them by evaporation, it resembles the Caspian and many other seas; as a sort of evaporating dish for the leachings of salt rock, and consequently holding a body of water unfit to support the higher forms of animal life, it resembles, among others, the Median lake of Urumiah; as a deposit of bitumen, it resembles the pitch lakes of Trinidad.

Striking, then, as was the Dead Sea in its appearance to prescientific man, there is nothing in it of extraordinary difficulty to the modern geologist or geographer.*

* For modern views of the Dead Sea, see the Rev. Edward Robinson, D. D., "Biblical Researches," various editions; Lynch's "Exploring Expedition"; De Saulcy, "Voyage

At a very early period, myths and legends, many and long, grew up to explain features then so incomprehensible.

As the myth and legend grew up among the Greeks of a refusal of hospitality to Zeus and Hermes by the village in Phrygia, and the consequent sinking of that beautiful region with its inhabitants beneath a lake and morass, so there came a belief in a similiar offense by the people of the beautiful valley of Siddim, and the consequent sinking of that valley with its inhabitants beneath the waters of the Dead Sea. Very similar to the accounts of the saving of Philemon and Baucis are those of the saving of Lot and his family.

But the myth-making and miracle-mongering by no means ceased in ancient times; they continued to grow through the me-

autour de la Mer Morte"; Stanley's "Palestine and Syria"; Schaff's "Through Bible Lands"; and other travelers hereafter quoted. For good "*photogravures*," showing the character of the whole region, see the portfolio forming part of De Luynes's monumental "Voyage d'Exploration." For geographical summaries, see Reclus, "La Terre," Paris, 1870, pp. 832–843; Ritter, "Erdkunde," volumes devoted to Palestine and especially as supplemented in Gage's translation with additions; Reclus, "Nouvelle Géographie Universelle," ix, 736, where a small map is given presenting difference in depth between the two ends of the lake, of which so much was made theologically before Lartet. For still better maps, see De Saulcy, and especially De Luynes, "Voyage d'Exploration" (portfolio). For very interesting panoramic views, see last edition of Canon Tristram's "Land of Israel," p. 635. For the geology, see Lartet, in his reports to the French Geographical Society, and especially in vol. iii of De Luynes's work, where there is an admirable geological map with sections, etc.; also Ritter; also Sir J. W. Dawson's "Egypt and Syria," published by the Religious Tract Society; also Rev. Cunningham Geikie, D. D., "Geology of Palestine"; and for pictures showing salt formation, Tristram, as above. For the meteorology, see Vignes, "Report to De Luynes," pp. 65 *et seq.* For chemistry of the Dead Sea, see as above, and Terreil's report, given in Gage's Ritter, vol. iii, Appendix 2, and tables in De Luynes's third volume. For zoölogy of the Dead Sea, as to entire absence of life in it, see all earlier travelers; as to presence of lower forms of life, see Ehrenberg's microscopic examinations in Gage's Ritter. See also reports in third volume of De Luynes. For botany of the Dead Sea, and especially regarding "apples of Sodom," see Dr. Lortet's "Palestine," p. 412; also Reclus, "Nouvelle Géographie," ix, 737. Also for photographic representations of them, see portfolio forming part of De Luynes's work, plate 27. On Strabo's very perfect description, etc., see lib. xvi, II, 44; also Fallmerayer, "Werke," pp. 177, 178. For names and positions of a large number of salt lakes in various parts of the world more or less resembling the Dead Sea, see De Luynes, iii, 242 *et seq.* For Trinidad "pitch-lakes," found by Sir Walter Raleigh in 1595, see Langegg, "El Dorado," Part I, p. 103, and Part II, p. 101; also Reclus, Ritter, *et al.* For the general subject, see Schenkel, "Bible Lexicon," *sub voc.* "Todtes Meer," an excellent summary. The description of the Dead Sea in Lenormant's great history is utterly unworthy of him, and must have been thrown together from old notes after his death. It is amazing to see in such a work the old superstition that birds attempting to fly over the sea are suffocated. See Lenormant, "Histoire ancienne de l'Orient," edition of 1888, vol. vi, p. 112. For the absorption and adoption of foreign myths and legends by the Jews, see Baring-Gould, "Myths," etc., p. 390. For the views of Greeks and Romans, see especially Tacitus, "History," Book V, Pliny, and Strabo, in whose remarks are the germs of many of the mediæval myths. For very curious examples of these, see Baierus, "De Excidio Sodomæ," Halle, 1705, *passim.*

diæval and modern period until they have quietly withered away in the light of modern scientific investigation, leaving to us the religious and moral truths they inclose.

It would be interesting to trace this whole group of myths: their origin in times prehistoric; their development in Greece and Rome; their culmination during the ages of faith; and their disappearance in the age of science. It would be especially instructive to note the conscientious efforts to prolong their life by making futile compromises between science and theology regarding them; but I shall mention this main group only incidentally, confining myself almost entirely to the one above named—the most remarkable of all—the myth which grew about the salt pillars of Usdum.

I select this mainly because it involves only elementary principles, requires no abstruse reasoning, and because all controversy regarding it is ended. There is certainly now no theologian with a reputation to lose who will venture to revive the idea regarding it which was sanctioned for hundreds, nay thousands, of years by theology, was based on Scripture, and was held by the universal Church until our own century.

The main feature of the salt region of Usdum is a low range of hills near the southwest corner of the Dead Sea, extending in a southeasterly direction for about five miles, and made up mainly of salt rock. This rock is soft and friable, and, under the influence of the heavy winter rains, it has been, without doubt, from a period long before human history, as it is now, cut ever into new shapes, and especially into pillars or columns, which sometimes bear a resemblance to the human form.

A clergyman who visited this spot about ten years since speaks of the appearance of this salt range as follows:

"Fretted by fitful showers and storms, its ridge is exceedingly uneven, its sides carved out and constantly changing; . . . and each traveler might have a new pillar of salt to wonder over at intervals of a few years."*

Few things could be more certain than that, in the indolent

* As to the substance of the "pillars" or "statues" or "needles" of salt at Usdum, many travelers speak of it as "marl and salt." Irby and Mangles, in their "Travels in Egypt, Nubia, Syria, and the Holy Land," chapter vii, call it "salt and hardened sand." The citation as to frequent carving out of new "pillars" is from the "Travels in Palestine" of the Rev. H. F. Osborn, D. D. See also Palmer, "Desert of the Exodus," ii, pp. 478, 479. For engravings of the salt pillar at different times compare that given by Lynch in 1848, when it appeared as a column forty feet high, with that given by Palmer as the frontispiece to his "Desert of the Exodus," Cambridge, England, 1871, when it was small and "does really bear a curious resemblance to an Arab woman with a child upon her shoulders"; and this again with the picture of the salt formation at Usdum given by Canon Tristram, at whose visit there was neither "pillar" nor "statue." See "The Land of Israel," by H. B. Tristram, D. D., F. R. S., London, 1882, p. 324.

dream-life of the East, myths and legends would grow up to account for this as for other strange appearances in all that region. The question which a religious Oriental put to himself in ancient times at Usdum was substantially that which his descendant today puts to himself at Kosseir: "Why is this region thus blasted?" —"whence these pillars of salt?" or "whence these blocks of granite?"—"what aroused the vengeance of Jehovah or of Allah to work these miracles of desolation?"

And, just as Maxime Du Camp recorded the answer of the modern Shemite at Kosseir, so the compilers of the Jewish sacred books recorded the answer of the ancient Shemite at the Dead Sea; just as Allah at Kosseir blasted the land and transformed the melons into bowlders which are seen to this day, so Jehovah at Usdum blasted the land and transformed Lot's wife into a pillar of salt which is seen to this day.

No more difficulty was encountered in the formation of the Lot legend, to account for that rock resembling the human form, than in the formation of the Niobe legend, which accounted for a supposed human resemblance in the rock at Sipylos; it grew up just as we have seen thousands of similar myths and legends grow up about striking natural appearances in every home of the human race. Being thus consonant with the universal view regarding the relation of physical geography to the divine government, it became a treasure of the Jewish nation and of the Christian Church—a treasure not only to be guarded against all hostile intrusion, but to be increased, as we shall see, by the myth-making powers of Jews, Christians, and Mohammedans for thousands of years.

The spot where the myth originated was carefully kept in mind; indeed, it could not escape, for in that place alone was constantly seen the phenomena which caused the myth. We have a steady chain of testimony through the ages all pointing to the salt pillar as the irrefragable evidence of divine judgment. That great theological test of truth—the dictum of St. Vincent of Lerins—would certainly prove that the pillar was Lot's wife; for it was believed so to be by Jews, Christians, and Mohammedans from the earliest period down to a time almost within present memory—"always, everywhere, and by all." It would stand perfectly the ancient test insisted upon by Cardinal Newman, "*Securus judicat orbis terrarum.*"

For, ever since the earliest days of Christianity, the identity of the salt pillar with Lot's wife has been universally held and supported by passages in Genesis, in St. Luke's Gospel, and in the Second Epistle of St. Peter—coupled with a passage in the book of the Wisdom of Solomon, which to this day, by a majority in the Christian Church, is believed to be inspired, and from which are

specially cited the words, "A standing pillar of salt is a monument of an unbelieving soul."*

Never was chain of belief more continuous. In the first century of the Christian era Josephus refers to the miracle, and declares regarding the statue, "I have seen it, and it remains at this day"; and Clement, Bishop of Rome, one of the most revered fathers of the Church, noted for the moderation of his statements, expresses a similar certainty, declaring that he knew the miraculous statue to be still standing.

In the second century that great father of the Church, bishop and martyr, Irenæus, not only vouched for it, but gave his approval to the belief that the soul of Lot's wife still lingered in the statue, giving it a sort of organic life; thus virtually began in the Church that amazing development of the legend which we shall see taking various forms through the middle ages—the story that the salt statue exercised certain physical functions which in these more delicate days can not be alluded to save under cover of a learned language.

This addition to the legend, which in these signs of life, as in other things, is developed almost exactly on the same lines with the legend of the Niobe statue in the rock of Mount Sipylos and the legends of human beings transformed into bowlders in various mythologies, was for centuries regarded as an additional confirmation of revealed truth.

In the third century the myth burst into still richer bloom in a poem long ascribed to Tertullian. In this poem more miraculous characteristics of the statue are revealed. It could not be washed away by rains; it could not be overthrown by winds; any wound made upon it was miraculously healed; and the earlier statements as to its physical functions were amplified in sonorous Latin verse.

With this appeared a new legend regarding the Dead Sea: it became universally believed, and we find it repeated throughout the whole mediæval period, that the bitumen could only be dissolved by such fluids as in the processes of animated nature came from the statue.

The legend thus amplified we shall find dwelt upon by pious travelers and monkish chroniclers for hundreds of years: so it came to be more and more treasured by the universal Church, and held more and more firmly—"always, everywhere, and by all."

In the two following centuries we have an overwhelming mass of additional authority for the belief that the very statue of salt

* For the usual biblical citations, see Genesis xix, 26; St. Luke xvii, 32; Second Peter ii, 6. For the citation from "Wisdom," see x, 7. For the account of the transformation of Lot's wife put into its proper relations with the Jehovistic and Elohistic documents, see Lenormant's "La Genèse," Paris, 1883, pp. 53, 199, and 317, 318.

into which Lot's wife was transformed was still existing. In the fourth the continuance of the statue was vouched for by St. Silvia, who visited the place: though she could not see it, she was told by the Bishop of Segor that it had been there some time before, and she concluded that it had been temporarily covered by the sea. In both the fourth and fifth centuries such great doctors in the Church as St. Jerome, St. John Chrysostom, and St. Cyril of Jerusalem agreed in this belief and statement; hence it was, doubtless, that the Hebrew word which is translated in the authorized English version "pillar," was translated in the Vulgate, which the vast majority of Christians believe divinely inspired, by the word "statue"; we shall find this fact insisted upon by theologians arguing in behalf of the statue, as a result and monument of the miracle, for over fourteen hundred years afterward.*

About the middle of the sixth century Antoninus Martyr visited the Dead Sea region and described it, but curiously reversed a simple truth in these words: "Nor do sticks or straws float there, nor can a man swim, but whatever is cast into it sinks to the bottom." As to the statue of Lot's wife, he threw doubt upon its miraculous renewal, but testified that it was still standing.

In the seventh century the Targum of Jerusalem not only testified that the salt pillar at Usdum was once Lot's wife, but declared that she must retain that form until the general resurrection. In the seventh century, too, Bishop Arculf traveled to the Dead Sea, and his work was added to the treasures of the Church. He develops the legend, and especially that part of it given by Josephus, greatly. The bitumen that floats upon the sea "resembles gold and the form of a bull or camel"; "birds can not live near it"; and "the very beautiful apples" which grow there, when plucked, "burn and are reduced to ashes, and smoke as if they were still burning."

In the eighth century the Venerable Bede takes these statements of Arculf and his predecessors, binds them together in his work on "The Holy Places," and gives the whole mass of myths and legends an enormous impulse.†

In the tenth century new force is given to it by the pious Mos-

* See Josephus, "Antiquities," 1, 1, chap. ii; Clement, "Epist.," 1; Cyril, "Hieros. Catech.," xix; Chrysostom, "Hom.," xviii, xliv in Genes.; Irenæus, lib. iv, c. xxxi, or cap. i, p. 354, edition Oxon., 1702. For St. Silvia, see "S. Silviæ Aquitanæ Peregrinatio ad Loca Sancta," Romæ, 1887, p. 55, also edition of 1885, p. 25. For legends of signs of continued life in bowlders and stones into which human beings have been transformed for sin, see Karl Bartsch, "Sagen," etc., vol. ii, pp. 420 *et seq.*

† For Antoninus Martyr, see Tobler's edition of his work in the "Itinera," i, p. 100, Geneva, 1877. For the Targum of Jerusalem, see citat. in Quaresmius, "Terræ Sanctæ Elucidatio," Peregrinatio vi, cap. xiv; new Venice edition. For Arculf, see Tobler. For

lem, Mukadassi. Speaking of the town of Segor, near the salt region, he says that the proper translation of its name is "Hell"; and of the lake he says, "Its waters are hot, even as though the place stood over hell-fire."

In the crusading period, immediately following, all the legends burst forth more brilliantly than ever.

The first of these new travelers who makes careful statements is Fulk of Chartres, who in 1100 accompanied King Baldwin to the Dead Sea and saw many wonders; but, though he visited the salt region of Usdum, he makes no mention of the salt pillar: evidently he had fallen on evil times; the older statues had probably been washed away, and no new one had happened to be washed out of the rocks just at that period.

But his misfortune was more than made up by the triumphant experience of a far more famous traveler, half a century later—Rabbi Benjamin of Tudela.

Rabbi Benjamin finds new evidences of miracle in the Dead Sea, and develops to a still higher point the myth and legend of the salt statue of Lot's wife, enriching the world with the statement that it was steadily and miraculously renewed; that, though the cattle of the region licked its surface, it never grew smaller. Again a thrill of joy went through the monasteries and pulpits of Christendom at this increasing "evidence of the truth of Scripture."

Toward the end of the thirteenth century there appeared in Palestine a traveler superior to most before or since—Count Burchard, monk of Mount Sion. He had the advantage of knowing something of Arabic, and his writings show him to have been observant and thoughtful. No statue of Lot's wife appears to have been washed clean of the salt rock during his visit, but he takes it for granted that the Dead Sea is "the mouth of hell," and that the vapor rising from it is the smoke from Satan's furnaces.

These ideas seem to have become part of the common stock, for Ernoul, who traveled to the Dead Sea during the same century, always speaks of it as the "Sea of Devils."

Near the beginning of the fourteenth century came a traveler of far wider influence—Sir John Maundeville.

In the various editions of the book ascribed to him, myths and legends of the Dead Sea and of the pillar of salt—old and new—burst forth into wonderful luxuriance. He brings news of a woman changed into an enormous dragon; of a monster who besought a monk to cast out the devil from him, and who had horns on his head, which horns were shown Maundeville by the monk

Bede, see his "De Locis Sanctis" in Tobler's "Itinera," i, p. 228. For an admirable statement of the mediæval theological view of scientific research, see Eicken, "Geschichte, etc., der Mittelalterlichen Weltanschauung," Stuttgart, 1887, chap. vi.

who told him the story. He gives full details of the phœnix rising from its own ashes. But all culminates at the Dead Sea.

He tells us that masses of fiery matter are every day thrown up from it as large as a horse; that, though it contains no living thing, it has been shown that men thrown into it can not die; and finally, as if to prove the worthlessness of devout testimony to the miraculous, he says: "And whoever throws a piece of iron therein, it floats; and whoever throws a feather therein, it sinks to the bottom; and, because that is contrary to nature, I was not willing to believe it until I saw it."

He of course mentions Lot's wife, and says that the pillar of salt "stands there to-day," and "has a right salty taste."

Great injustice has been done to Maundeville in holding him a liar of the first magnitude. Never was man further from the thought of lying. He simply abhorred skepticism, and thought it meritorious to believe all pious legends. The ideal Maundeville was a man of overmastering faith, and resembled Tertullian in believing things "because they are impossible"; he was entirely conscientious; the solemn ending of the book shows that he listened, observed, and wrote under the deepest conviction, and those who re-edited his book were probably just as honest in adding the later stories of pious travelers.

The "Travels of Sir John Maundeville," thus appealing to the popular heart, were most widely read in the monasteries and repeated among the people. Innumerable copies were made in manuscript, and finally in print, and so the old myths received a new life.*

In the fifteenth century wonders were increased. In 1418 we have the Lord of Caumont, who makes a pilgrimage and gives us

* For Fulk of Chartres and Crusading travelers generally, see Bongar's "Gesta Dei per Francos," *passim*; also histories of the Crusades by Wilkins, Poujoulat, and others. See also Robinson, "Biblical Researches," ii, 109, and Tobler, "Bibliographia Geographica Palestinæ," 1867, p. 12. For Benjamin of Tudela's statement, see Wright's "Collection of Travels in Palestine," p. 84, and Asher's edition of Benjamin of Tudela's travels, vol i, pp. 71, 72; also Charton, vol. i, p. 180. For Borchard or Burchard, see full text in the "Reyssebuch dess Heyligen Landes"; also Grynæus, "Nov. Orbis," Basil., 1532, folio 298, 329. For Ernoul, see his "L'Estat de la Cité de Hierusalem," in Michelin and Raynaud, "Itinéraires Françaises au 12me et 13me Siècles." For Petrus Diaconus, see "Petri Diaconi de Locis sanctis," edited by Gamurrini, Rome, 1887, pp. 126, 127. For Maundeville I have compared several editions, especially those in the "Reyssebuch," in Canisius and in Wright, with Halliwell's reprint and with the rare Strasburg edition of 1484 in the Cornell University Library: the whole statement regarding the experiment with iron and feathers is given differently in different copies. The statement that he saw the feathers sink and the iron swim is made in the Reyssebuch edition, Frankfort, 1584. The story, like the saints' legends, evidently grew as time went on, but is none the less interesting as showing the general credulity. Since writing the above I have been glad to find my view of Maundeville's honesty confirmed by the Rev. Dr. Robinson, and by Mr. Gage in his edition of Ritter's "Palestine."

a statement which is the result of the theological reasoning of centuries, and especially interesting as a typical example of the theological method in contrast with the scientific. He could not understand how the blessed waters of the Jordan could be allowed to mingle with the accursed waters of the Dead Sea. In spite, then, of the eye of sense, he beheld the water with the eye of faith, and calmly announced that the Jordan water passes through the sea, but that the two masses of water are not mingled. As to the salt statue of Lot's wife, he declares it to be still existing; and, copying a table of indulgences granted by the Church to pious pilgrims, he puts down the visit to the salt statue as giving an indulgence of seven years.

Toward the end of the century we have another traveler yet more influential, Bernard of Breydenbach, Dean of Mainz. His book of travels was published in 1486, at the famous press of Schoeffer, and in various translations it was spread through Europe, exercising an influence wide and deep. His first important notice of the Dead Sea is as follows: "In this, Tirus the serpent is found, and from him the Tiriac medicine is made. He is blind, and so full of venom that there is no remedy for his bite except cutting off the bitten part. He can only be taken by striking him and making him angry; then his venom flies into his head and tail." Breydenbach calls the Dead Sea "the chimney of hell," and repeats the old story as to the miraculous solvent for its bitumen. He, too, makes the statement that the holy water of the Jordan does not mingle with the accursed water of the infernal sea; but increases the miracle which Caumont had announced by saying that, although the waters appear to come together, the Jordan is really absorbed in the earth before it reaches the sea.

As to Lot's wife, various travelers at that time had various fortunes. Some, like Caumont and Breydenbach, took her continued existence for granted; some, like Count John of Solms, saw her and were greatly edified; some, like Hans Werli, tried to find her and could not, but, like St. Silvia, a thousand years before, were none the less edified by the idea that, for some inscrutable purpose, the sea had been allowed to hide her from them; some found her larger than they expected, even forty feet high, as was the salt pillar which happened to be standing at the visit of Commander Lynch in 1848; but this only added a new proof to the miracle, for the text was remembered, "There were giants in those days."

Out of the mass of works of pilgrims during the fifteenth century I select just one more as typical of the theological view then dominant, and this is the noted book of Felix Fabri, a preaching friar of Ulm.

I select him, because even so eminent an authority in our own time as Dr. Edward Robinson declares him to have been the most thorough, thoughtful, and enlightened traveler of that century.

Fabri is greatly impressed by the wonders of the Dead Sea, and typical of his honesty influenced by faith is his account of the Dead Sea fruit; he describes it with almost perfect accuracy, but adds the statement that when mature it is "filled with ashes and cinders."

As to the salt statue, he says: "We saw the place between the sea and Mount Segor, but could not see the statue itself because we were too far distant to see anything of human size; but we saw it with firm faith, because we believed Scripture, which speaks of it; and we were filled with wonder."

To sustain absolute faith in the statue he reminds his readers that "God is able even of these stones to raise up seed to Abraham," and goes into a long argument, discussing such transformations as those of King Atlas and Pygmalion's statue, with a multitude of others, winding up with the case, given in the miracles of St. Jerome, of a heretic who was changed into a log of wood, which was then burned.

He gives a statement of the Hebrews that Lot's wife received her peculiar punishment because she had refused to add salt to the food of the angels when they visited her, and he preaches a short sermon in which he says that, as salt is the condiment of food, so the salt statue of Lot's wife "gives us a condiment of wisdom." *

There were indeed many discrepancies in the testimony of travelers regarding the salt pillar—so many, in fact, that at a later period the learned Dom Calmet acknowledged that they shook his belief in the whole matter; but, during this earlier time, under the complete sway of the theological spirit, these difficulties only gave new and more glorious opportunities for faith.

For, if a considerable interval occurred between the washing of one salt pillar out of existence and the washing of another into existence, the idea arose that the statue, by virtue of the soul which still remained in it, had departed on some mysterious excursion; did it happen that one statue was washed out one year in one place and another statue another year in another place, this difficulty was surmounted by believing that Lot's wife still walked about; did it happen that a salt column was undermined by the rains and fell, this was believed to be but another sign of life; did

* For Bernhard of Breydenbach, see marked pages in the Latin edition, Mentz, 1486, in the White collection, Cornell University, also in German edition in the "Reyssebuch"; for John of Solms, Werli, and the like, see the "Reyssebuch," which gives a full text of their travels. For Fabri (Schmid), see, for his value, Robinson, also Tobler, "Bibliographia," 53 *et seq.*; and for texts the "Reyssebuch," 122b *et seq.*, but best the "Fratris Fel. Fabri Evagatorium," ed. Hassler, Stuttgart, 1843, iii, 172 *et seq.*

a pillar happen to be covered in part by the sea, this was enough to arouse the belief that the statue from time to time descended into the Dead Sea depths—possibly to satisfy that old fatal curiosity regarding her former neighbors; did some smaller block of salt happen to be washed out near the statue, it was believed that a household dog, also transformed into salt, had followed her back from beneath the deep; did more statues than one appear at one time, that simply made the mystery more impressive.

In facts now so easy of scientific explanation the theologians found wonderful food for discussion.

One great question among them was whether the soul of Lot's wife did really remain in the statue. On one side it was insisted that, as Holy Scripture declares that Lot's wife was changed into a pillar of salt, and as she was necessarily made up of a soul and a body, the soul must have become part of the statue. This argument was clinched by citing that passage in the Book of Wisdom in which the salt pillar is declared to be still standing as "the monument of an unbelieving *soul*." On the other hand, it was insisted that the soul of the woman must have been incorporeal and immortal, and hence could not have been changed into a substance corporeal and mortal. Naturally, to this it would be answered that the salt pillar was no more corporeal than the ordinary materials of the human body, and that it had been made miraculously immortal, and that "with God all things are possible." Thus long vistas of theological discussion were opened.*

As we enter the sixteenth century the Dead Sea myths, and especially the legends of Lot's wife, are still growing. In 1507 Father Anselm of the Minorites declares that the sea sometimes covers the feet of the statue, sometimes the legs, sometimes the whole body.

In 1555 Gabriel Giraudet, priest at Puy, journeyed through Palestine. His faith was robust, and his attitude toward the myths of the Dead Sea is seen by his declaration that its waters are so foul that one can smell them at a distance of three leagues; that straw, hay, or feathers thrown into them will sink, but that iron and other metals will float; that criminals have been kept in them three or four days and could not drown. As to Lot's wife, he says that he found her "lying there, her back toward heaven, converted into salt stone; for I touched her, scratched her, and put a piece of her into my mouth, and she tasted salt."

At the center of all these legends we see, then, the idea that, though there were no living beasts in the Dead Sea, the people of the overwhelmed cities were still living beneath its waters, prob-

* For a brief statement of the main arguments for and against the idea that the soul of Lot's wife remained within the salt statue, see Cornelius a Lapide, "Commentarius in Pentateuchum," Antwerp, 1697, chap. xix.

ably in hell; that there was life in the salt statue; and that it was still curious regarding its old neighbors.

Hence such travelers in the latter years of the century as Count Albert of Löwenstein and Prince Nicholas Radzivill are not at all weakened in faith by failing to find the statue; what the former is capable of believing is seen by his statement that in a certain cemetery at Cairo during one night in the year the dead thrust forth their feet, hands, limbs, and even rise wholly from their graves.

There seemed, then, no limit to these pious beliefs. The idea that there is merit in credulity, with the love of myth-making and miracle-mongering, constantly made them larger. Nor did the Protestant Reformation, which now came in, diminish them at first; it rather strengthened them and fixed them more firmly in the popular mind. They seemed destined to last forever. How they were thus strengthened at first, under Protestantism, and how they were finally dissolved away in the atmosphere of scientific thought, will be shown in the following chapter.*

THE LOCALIZATION OF INDUSTRIES.

By J. J. MENZIES.

AMONG the ancient peoples of the far East any exchange of productions was necessarily on a small scale. Means of transport were limited—by land, to the backs of men and animals; and by water, to rivers and such lakes or inland seas as could be safely navigated by small and rudely constructed boats. Most commodities were raised, manufactured, and consumed within very restricted areas, with little division of labor; and excepting naturally abundant agricultural products and domestic animals were, therefore, inferior and expensive, and men could only accommodate themselves to variations in crops by lavish consumption when they were abundant, and by starvation when they were scanty. In later times, the art of navigation was so far improved as to extend trading along the shores of the Mediterranean, and eventually across it, by which means countries situated round about that great inland sea were brought into close communication with each other, a rapid advance in the arts and sciences resulted, countries hitherto little known were explored, a larger exchange of commodities was effected, and surpluses and deficits were made to bal-

* For Father Anselm, see his "Descriptio Terræ Sanctæ," in H. Canisius, "Thesaurus Monument. Eccles.," Basnage edition, Amsterdam, 1725, vol. iv, p. 788. For Giraudet, see his "Discours du Voyage d'Oultre Mer . . . et autres Lieux de la Terre Saincte," Paris, 1585, p. 56a. For Radziwill and Löwenstein, see the "Reyssebuch," especially p. 198a.

ance each other. Still later navigation reached to all the shores of the Old World, and finally into the Western hemisphere. With every addition to the field of human knowledge and enterprise there was a corresponding increase in the volume of exchanges and in the variety of manufactures and useful conveniences. Each country and district parted with that which it had in superabundance, or was particularly skilled in producing, for goods that were scarce or wanting to it, or that its own artificers were not accustomed to manufacture.

The same system of operations continues extending at the present day, and may do so apparently for an indefinite time. Every new country brought under cultivation, every new discovery of the treasures of the earth and waters, every new appliance adding to our powers and to our facilities of communication, and even every increase in itself in the sum of trading operations, forms the basis of new exchanges to mutual advantage; for the greater the quantities the smaller the profit at which it will pay to exchange them. Experience keeps constantly adding to our knowledge of the special advantages of each locality, and every free movement of trade and industry increases the sum of their usefulness to the human race. Scarcity of food can no longer exist among nations that have kept abreast of this economical revolution. The aggregate of comforts and luxuries generally attainable has multiplied enormously, and the mere operations of exchange give directly and indirectly steady and profitable employment to vast numbers. Nor is this freer exchange of commodities and of ideas attended, as many suppose, by increased competition between men and nations, for it is accompanied by a better and more wide-spread division of labor, and men by degrees cease to produce these articles in which they are manifestly at a disadvantage, and the disposal of which entails loss and disappointment. Those who doubt the advantages of this universal, world-wide intercourse and exchange are bound in consistency to advocate the reversion of society not merely to any earlier stage in its development, but to that state of things which preceded its initiation—that is, to pure and simple cannibalism; for an argument that is good against one step in this march of progress is equally good against another. As it is certain, too, that this same movement, in spite of wars and governmental interferences, is constant and resistless, there can be no more important question than how best to conform to and profit by it, which we may learn by observing how men and nations naturally find their most suitable and profitable occupations.

The general principles determining the employment of the soil of different countries and localities are tolerably simple. Com-

mon, bulky, and perishable articles are naturally produced as near as possible to the places of consumption, though improvements enabling them to be more easily and cheaply transported render them more available for distant markets. Such are the compression and baling of hay, the conveyance of dead meats in refrigerated chambers, of live animals in specially adapted wagons and steamships, and of ordinary fresh fruits and vegetables by express trains. More valuable articles and luxuries, such as the finer fruits, sugar, tobacco, and cotton, the cost of transport of which is relatively less important, can and often must be produced in localities specially adapted to them at greater distances from the places of their eventual consumption. Dried fruits are more fitted for distant and uncertain markets than green fruits. Other generally esteemed articles, such as silk, tea, and the finer wines, naturally monopolize the limited areas capable of producing them. On the other hand, as almost any part of the world can grow wheat and the ordinary small grains by the employment of a comparatively limited capital, as the cost of transporting them is inconsiderable, as they are not liable to spoil, and as the enormous quantities in which they are handled and the universal competition among producers of them enable and necessitate their being turned over at the minimum profits, the growth of these indispensable staples is left to the newest, the poorest, and the most remote countries, and to those parts of other countries for which no better employment can be found. A decline in the production of these articles is a sign, beyond doubt, of the increasing wealth of a country, and that it has found better employments for its capital and labor. This is especially noticeable in England, Germany, France, and our own Eastern States; and California also, it may be noted, is discontinuing the production of grain as rapidly as she can find a market for her higher class articles. A still more decided move in the same direction is only restrained in England by the uncertainty of the climate, and the consequent danger of devoting too great an area to pasturage, green crops, fruit, or hops, since an excess of drought is adverse to the first two, and an excess of moisture to the others. The future order of cultivation in the United States is dependent chiefly on the development by irrigation of the vast arid regions of the West, and upon the nature of the resources which may thereby be disclosed, as also upon the description and extent of the trade just beginning between our Pacific coast, Japan, China, Australia, and New Zealand, and that to open up later with the East by the Central American interoceanic canal. It is already certain that the convenient position of California for this trade, her variety of climate and elevation, and resulting adaptability for a great choice of productions, insures for her, through the extension of irrigation, a great and

distinctive future. If her wine trade be not as yet as prosperous as she could wish, no one need be surprised at this who has remarked the specialties of character in the different European wines, and considered the centuries of labor and application that have been required to evolve these varied types as the most appropriate to their several localities, as also the great capital employed at low rates of interest in maturing these wines and in educating the tastes of consumers thereto. The production of wool on a large scale is a natural resource of mountainous countries and of regions distant from centers of population, as we see in Wales, portions of Scotland, Germany, and the United States. The marked devotion of Australia to this industry is due to the sudden opening of her unlimited territories, to the nature of her climate, suitable for the rearing of sheep, and to her rainfall, too limited and uncertain for profitable cultivation. Added to these causes is her remoteness from other countries, which, making impossible the export of the animals themselves, dead or alive, on an adequate scale, has allowed her flocks to increase almost unchecked.

As we already saw in the case of the common and bulky natural products, so it is with the corresponding class of manufactured goods; they can not well bear a long and expensive carriage, and therefore, other things being equal, are naturally produced as near as possible to their places of consumption. As in the United States there are numerous contiguous deposits of coal and iron, those most convenient to the large centers of population have been in the mean time utilized, both for fuel and for the heavy iron manufactures, rails, pipes, and machinery, that the various purposes of such communities call for on a great scale. When such articles must necessarily be sent to long distances, those points most convenient to water-carriage are naturally preferred for their production. Pittsburgh is a notable instance of this, also the English, Scotch, Welsh, and Australian coal ports, from which this indispensable mineral is shipped to every part of the world. When especially it is desirable for some manufactures to mix the heavier metals of different countries, such operations must necessarily take place at or near some convenient port. Thus, tin mined in Cornwall is taken to Swansea, the nearest port having iron-works, when required for making tin plates, and imported ores are, by the use of the adjacent coal, also smelted there, as well as at various coal ports in the northwest coast of England and elsewhere. The convenience of both coal and iron has made the river Clyde the chief seat of iron ship-building, just as its local timber made Boston that of wooden ship-building. Makers of boilers, engines, and heavy machinery at Manchester, England, have also discovered that even the thirty miles of rail carriage to Liverpool,

and the rehandling there, handicap them in competition with Glasgow shippers of the same articles, which is one of the chief reasons for the construction, now in progress, of the Manchester ship-canal. In countries where deposits of coal and iron are comparatively rare, as in France, Germany, and elsewhere, the favored spots necessarily become themselves the chief centers of manufacture and population. Furniture is a rather bulky and expensive article to move about, and its manufacture, for use through a large portion of the United States, has found an appropriate and central position at Grand Rapids, Mich., where the most useful native timbers and water-power are in abundance.

The lighter metal and wood manufactures, the textiles, leather, pottery, and miscellaneous small wares, in which the cost of transport is relatively less important, are determined, as to their location, by a much greater complexity of conditions, and the general rules on this point are subject, in their case, to variation from specially dominant influences. In order to combine the most obvious advantages, they should not be situated too far from a supply of coal and iron, should be convenient to the sources of their raw material, whether home or foreign, and to the markets where their finished products are expected to find a sale. While, too, each article and department of manufacture will usually succeed best around a center of its own, where a skilled and adapted population has become settled, it is still more important that all should be conveniently clustered for mutual assistance. While these conditions are more or less generally complied with in all great manufacturing countries, they are most completely so in Great Britain, partly by reason of its natural facilities, partly owing to the absence of any fiscal interference by their own Government. Thus it may be observed that the location of the cotton manufacture in Lancashire, of the woolen in Yorkshire, and of the lighter metal and miscellaneous in and around Birmingham, is in compliance with those principles, as well as the subdivision and specialization of all these various industries, many of which and similar ones may also be found in Scotland, which, to a certain extent, is a smaller independent center. Subject to necessary geographical differences, the location and arrangement of similar manufactures in the United States and on the European continent follows as nearly as possible the same conditions. Only in New England had we in existence a population capable of successfully undertaking the production of the great variety of those articles when prematurely called for by the imposition of our high protective tariff on their importation; and the situation of that country, in a corner, as it were, of our territory, and without local supplies of coal and iron, is not all that could be desired for the purpose. True, its seaports, convenient for coastwise navigation, its abundant water-

power, and its supply of native wool and timber, to a great extent set off these disadvantages, though probably not completely.

The free commercial policy of Great Britain, united with the combination in a small, centrally situated space of country of all the most desirable facilities, marks her out as the greatest of international manufacturing and trading countries. Her manufacturers have perfect liberty to purchase their raw or partially manufactured materials in the best and cheapest markets; and their constant intercourse with all parts of the world keeps them informed of every new invention and resource. Their own home market is one of the most important, and, having no protection therein, they know at once when they are excelled in the production of any article, and whether it is owing to any natural or acquired advantage, so that among them there is very little waste of effort. Extent of capital hitherto undreamed of, ready to back their efforts abroad by investments in every promising enterprise, also enables them to command a preference in many undeveloped and poor countries. Yet it would be a great error to suppose that there do not exist in many other countries advantages sufficient to enable them also to carry on a large export business in manufactured goods. All are able to utilize some native materials and to save the intermediate profits and carriages upon foreign wares, and without doubt there are many wants that are best understood by the native manufacturers. Crippled as their producers are by fiscal restrictions upon their purchases and combinations, several of them are even now able to sell their wares largely to England herself. The artisans of the European continent are willing to work during a greater number of hours daily and for lower wages than those of Great Britain, and the cost of production is thereby diminished; and there are always in each country some advantages peculiar to itself and its population. Thus, France has a specialty in artistic taste, which enables her to supply the English market with most of its silks and ornamental objects, as well as with large quantities of fine woolen fabrics. Germany, the best educated country in the world, excels in applied science, as in the working of metals and stained glass; and the United States in labor-economizing apparatus, such as agricultural, sewing, and printing machines. Belgium has supplied wrought-iron girders for the roofs of English and Scotch railway stations. England also exports large quantities of partially manufactured goods, such as yarns, chemicals, and pig-iron, showing that the importing countries have, in various ways, superior facilities for the finishing processes. She also has need of the co-operation of other countries for the perfecting of her own wares. Thus, the finest flax grown in the north of Ireland, in order to attain its highest quality, must be sent to Belgium to be

steeped in the water of a certain river. Returning from there, it is spun into superfine yarns by the best machinery and in the naturally adapted moist climate of Belfast. At that stage the product is again sent back to Belgium, where it is woven into gossamer-like cambrics, in low, damp cellars, and under conditions that would not be agreeable to the north of Ireland artisan, and the work of the Belgian hand-loom weaver must then be carried back to be bleached under the dripping skies of the Green Isle. England is, besides, herself the largest and readiest buyer of all improved articles of necessity and luxury, from whatever source arriving; and, while usually the first to open up new markets, in none does she lay claim to any exclusive privilege.

There is, indeed, ample room in the natural economy of production for the services of all nations, and none need stand idle. Co-operation, not hostility and jealousy, should be the watchword of modern industrial enterprise. We ought, in the interest of producer and consumer alike, to remove all fiscal shackles from our trade and manufactures. European governments, hampered with the expenses of an all-devouring militarism, may be unable to abandon any source of revenue, however demoralizing in its incidence or costly in its collection. They may also fear the effects upon their own stability of even a temporary disturbance of existing employments. But neither of these objections can be of any weight with a nation perplexed only with the disposal of its surplus revenues, and whose reposing might need fear no foreign attack. In the enormous extent of our partially developed territorial resources, and no less in our wealth of inventiveness, now but half utilized, there can be no scarcity of employment for capital and labor, nor can we find any such profitable investment for our hoarded millions as the release of our capitalists and artisans, by just indemnities and pensions, from the demoralizing servitude of state-supported industries. In the past we have misdirected their energies and squandered their resources, and we owe them some compensation. Let us all make a new start by working in alliance with Nature, and no longer in ignorant opposition to her. Let each industry freely settle where it may, in our territory or out of it, and within the lifetime of many already middle-aged we shall see progress in the wealth of our country, and in the growth and contentment of our population, far surpassing all our previous experience.

A NEW view into the conditions and international relations of the remote past is given by Dr. Lehmann, of Berlin, in a paper on "Ancient Metrology." His showing that the Egyptian system of weights and measures, instead of being the origin of that of Babylonia, presupposes the sexagesimal system of the latter, if confirmed, would indicate the existence of commercial intercourse between Babylonia and Egypt at a time of which we have at present no contemporaneous records.

THE EVOLUTION OF THE MODERN RAILWAY BRIDGE.

By Prof. CHARLES DAVIS JAMESON,
of the State University of Iowa.

A BRIDGE is a structure over a river, ravine, or other opening, for the purpose of sustaining a *moving* load. This, in the case of a railroad bridge, consists of a heavy locomotive and train coming on at one end, rushing rapidly over the bridge, and off at the other end. This fact, that the load to which bridges are subjected is a moving load applied for only a short period of time and then removed, is a most important factor to be considered in calculating the necessary strength of the various members, as the strain produced in any piece of material by the application of a load is nearly doubled when the load is applied quickly as compared with that produced by the same load when applied gradually.

Bridges may be divided into the following classes: 1. The beam or girder. 2. The framed truss. 3. The arch. 4. The suspension bridge.

The most ordinary form which we see in this country, and the one most generally used for the purpose of railway bridges, is the framed truss, and that is the one the development of which it is our purpose to show.

The one point to be carefully studied in all bridge construction is economy—that is, to get as much strength with as little material as possible; in other words, the maximum amount of strength with the minimum amount of material.

The simplest method of crossing any opening where the dimensions of the opening are not so great, or the load so heavy, as to forbid its use, is by means of a plank placed from one side to the other, making the plank of such a length that the ends may have sufficient bearing upon each side of the opening (Fig. 1).

Fig. 1

In crossing an opening by means of a simple plank or beam, supposing we make the beam large enough, it answers every purpose and will hold up the required load. But in this there is great waste of material. We will take, for example, a plank twelve inches wide, and three inches deep, over an eighteen-foot opening—that is, the plank would have to be about twenty-one or twenty-two feet long, in order to allow the ends sufficient bearing surface upon the masonry on each side. This plank would hold up a certain amount of weight, but, as the weight is increased, in

a very short time the plank would begin to bend and buckle in the center. In order to increase the strength of this primitive bridge, we could place another plank beside it, making the bridge twenty-four inches wide, and, if the passing load were made to bear upon the entire width of this bridge, of course the bridge would bear just twice as much as one plank; but, in order to double the strength of the bridge, we have also doubled the amount of material necessary in its construction, and therefore have not in any way increased the economy.

This system might be carried on to infinity, and almost any amount of required strength be obtained by placing a sufficient number of planks one beside the other. But, returning again to the two planks, instead of placing them one beside the other, suppose we place one plank on top of the other, and nail them together firmly, so that they shall act as one plank (Fig. 2). We

Fig. 2

then have a bridge eighteen feet long, twelve inches wide, and six inches deep. In this bridge we have exactly the same amount of material we had when the two planks were placed side by side, but we have four times as strong a bridge instead of only twice; that is, we have doubled the amount of material, but we have multiplied the strength by four.

If one plank would hold up one hundred pounds on the center, then the two planks placed side by side would hold up two hundred pounds; while, placing the planks one on top of the other, and nailing them firmly together, they would hold up four hundred pounds. In this way we see that, in order to increase the strength of the bridge or beam faster than we increase the amount of material, the increased amount of material should go into the depth of the beam and not into the width of it. This is one of the first principles in the resistance of material, that the strength of a beam varies directly as the width—that is, if we make the beam twice as wide, it will hold twice as much; and that the strength varies as the square of the depth—that is, if we make it twice as deep, it will hold up four times as much. If we make it three times as deep, it will hold up nine times as much of a load. So that you can readily understand that, in order to increase the strength of the bridge or beam without increasing the material in the same proportion, the increased amount of material should be put into the depth and not into the width.

We now have a bridge twelve inches wide and six inches deep, which will hold up four times as much as our original bridge, twelve inches wide and three inches deep, and the amount of material is simply doubled. To advance one step beyond this,

suppose we take one of the planks and stand it up edgewise, and then place the other plank upon its flat side upon the top of this, as shown in Fig. 3, and nail the planks firmly together.

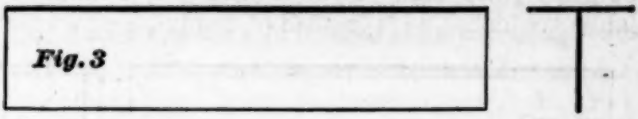


Fig. 3

We now have a bridge twelve inches wide, as we originally had, but fifteen inches deep, or what is known as the T-bar or girder, and the only difficulty about this bridge is the trouble in making it stand up; being so much higher than it is wide, it has a great tendency to tip over. But supposing the planks are made to stand in this shape, which is a simple matter, we then have a bridge fifteen inches deep, which will hold about seven times as much load as the original plank. Of course, if the bridge were made fifteen inches deep and the same width, that is, twelve inches wide, it would hold twenty-five times as much as the original bridge; but by turning one of the planks upon the edge we have increased the depth and decreased the breadth, so that the breadth of the bridge under the top plank is only one fourth of what it was before, and the total strength of the bridge is from seven to eight times that of the original plank. Now, in order to obviate some of the difficulty in making this bridge stand up, suppose we take the plank that is upon the edge and make two planks, each of them twelve inches wide but only an inch and a half thick, and then nail the floor plank upon the edges of this, making an inverted box, as shown in Fig. 4. We then have a bridge that there is no trouble in making stand, as it has twelve inches of bearing surface, and we have the same amount of strength as when it was in the shape of the T-bar, and we have what is technically known as the U-bar or channel-bar.

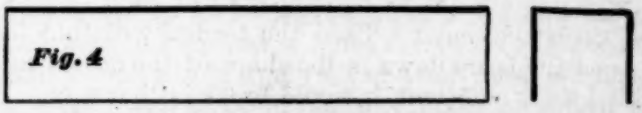


Fig. 4

In this U-bar there is this trouble: that, having the sides only an inch and a half thick and twelve inches deep, there is a tendency to bend in the sides—that is, a tendency to give sidewise; and in order to obviate this we take the top plank and split it in two, making two planks twelve inches wide and an inch and a half thick. Nail one on the top and the other on the bottom: we get what is called a box girder (Fig. 5), and which has about nineteen times the strength of the original three-inch plank and only double the amount of material.

So far we have considered our bridge as being only twelve

inches wide. We now wish a bridge wider than this, but with no more material in it except what may be needed in order to make the floor. Suppose we take the top and bottom plank of this box girder, cut them in two lengthwise, making out of each two planks six inches wide instead of twelve, and we fasten these

Fig. 5

upon each of the vertical planks, as shown in the drawing. We then have what is technically known as an I-bar, or flanged girder (Fig. 6). Provided these flanged girders are so braced as to prevent their bending sideways, the two flanged girders are of exactly the same strength as the box girder, and, as you see, can be placed at any distance apart, and the floor simply placed on top of them or on the lower flange, and we have a bridge as wide as we wish, with the strength of the box girder.

This I-bar, or flanged girder, is one of the most generally used forms of construction for bridges of short spans.

So far we have considered the material used to be simply wood, but I-bars are now made of iron or steel, and within the last few

Fig. 6 *Fig. 6 A.*

years entirely of steel, owing to the fact that the improved method of making steel has rendered it even cheaper than wrought iron.

Let Fig. 6 represent a side-view of the flanged girder, or I-bar, of which Fig. 6 A is an end-view.

Suppose this beam to be supported at each end and a load placed upon the center. Then the tendency of that load would be to bend the beam down in the shape of the dotted line, and, in case the load is sufficient, it would break in that way.

Before the breaking-point is reached the top and bottom of this beam are subjected to totally opposite classes of strain, as you will see. If you bend the beam, the tendency in the bottom of it is to pull the beam apart, or, in technical language, the bottom flange of the beam is in tension—tension being the force which tends to pull apart the particles of the beam. Thus, if you take a string fastened at one end, and hang a weight on the other end, the string is in tension, the action of the weight being to pull the particles of the string apart.

The top flange of the beam is in compression—that is, the

particles of which the beam is composed are forced together. It is the same strain obtained if you take a vertical post and put a weight on top of it; that weight tends to force together the particles of the post, and the post is said to be in compression.

It is well to get a thorough understanding of these two kinds of strains, as they are the principal strains that have to be considered in all bridge-building. There is a point between the top and bottom of the beam at which the character of the strain changes from compression into tension, where there is no strain at all, and the amount of strain in the beam decreases from the outside toward the center until this zero-point, or *neutral plane*, is reached; and, as the greater part of the strain comes upon that portion of the beam farthest from the center, you will at once see the economy and necessity of placing as much of the material as far from the center as possible—that is, placing the material where it is going to do the most work, and this is what has led to the adoption of the flanged girder, or I-beam, as a favorite method of construction. The principal part of the material is placed at the two outside edges of the beam where the strain is the greatest, and the amount of material between these two outside flanges is simply enough to keep the flanges apart.

As the size of the opening to be crossed increases, the size of the flanged girder necessary to hold up a given load increases, so that in a very short time the piece of iron or steel necessary becomes so large as to make it almost impossible to handle if it is all in one piece, and also a great deal of the material in the flanged girder is absolutely of no use—that is, a great deal of it can be cut away and used to more advantage in other places.

This leads us at once to the framed truss or framed girder. There is one thing in connection with framed trusses to which I wish to call your attention, and that is, the whole foundation of the framed truss is based upon a triangle. You will readily see the object of this. Suppose four pieces of timber are framed to-

Fig. 7

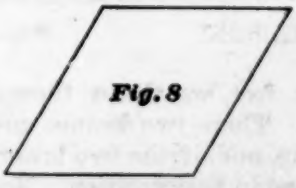


Fig. 8

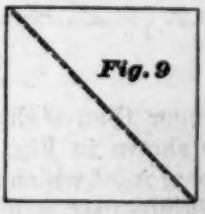


Fig. 9

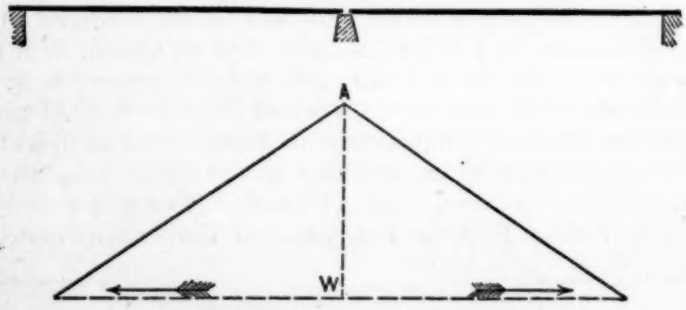
gether, as shown in the drawing (Fig. 7), in the form of a square or rectangle. Then any strain coming upon one side of this rectangle tends to change the form of the figure, and, unless the joints are made perfectly stiff, the rectangle is changed to the shape shown in Fig. 8, where every piece is of its original length, and

simply the angles have been changed. Now, suppose we divide this rectangle, by means of a brace or tie, into two triangles. Then not one of these timbers can be moved, or the form of the rectangle changed in any way, without lengthening or shortening the diagonal which divides it into triangles, and, therefore, the rectangle with the brace and tie forms a perfectly rigid figure (Fig. 9).

In other words, the triangle is the only figure the form of which can not be changed without changing the length of one of the sides; and thus any truss, to be perfectly braced and able to withstand any strains that come upon it, must be framed so as to be divided into a series of triangles.

Returning to our original beam thrown across an opening, we will suppose that we have a beam long enough and strong enough with the required load to cross an opening eighteen feet wide, and that we have an opening thirty-six feet wide which we wish to cross. That could be done by building a pier in the center of the opening and dividing it into two openings, each eighteen feet, as shown in Fig. 10; but, in the case of a bridge over a road or over a small river, it would not be advisable to block up the way by this pier, and some other method must be found to support the two inner ends of the beams. The simplest plan of doing it is shown in Fig. 11. Taking two beams that are each slightly

Fig. 10

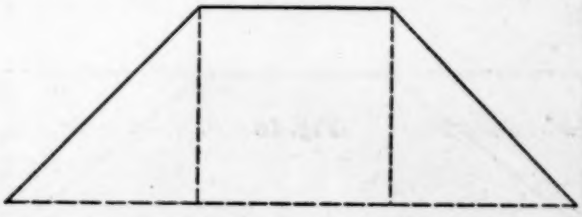


KING POST *Fig. 11*

longer than eighteen feet, we throw them across the opening, as shown in Fig. 11. These two beams meet at the angle, the apex, A, of which is up, and, if the two lower ends are kept from sliding apart, will stand in that position. Now, if from the angle where these two beams meet we let down a rope or iron rod, run out the floor beams eighteen feet long, and connect the inner end of each to this rope or rod, we have a bridge covering an opening thirty-six feet long—that is, one end of each floor beam rests upon the ground, the other end is sustained by the rope or

iron rod, and all the weight upon these ends of the beams passes up the rod, and then comes down the two diagonal beams to the abutments. The one thing necessary in this is that the lower ends of the two diagonal beams shall be so fixed as to make it impossible for them to slip out in the direction of the arrows, and this object is usually attained by making the floor stringers serve as a tie to hold them together. In the drawings, the full black lines are in compression and the dotted lines are in tension. Thus, you see the vertical rod or rope in the center is in tension—that is, a weight being at W, all of that weight comes directly upon the rod and is carried to the apex, A; then half of it passes to each side down the inclined braces, and they are in compression. The tendency at the foot of these braces is for them to slip out in the direction of the arrows. They are held together by the tie-rod or floor stringers, which are in tension. In regard to tension and compression, you may get a better comprehension of them if you understand that a cord or rope can be used for any member of a bridge that is in tension, while a post or some stiff piece of timber or iron is necessary for anything in compression—that is, in all these diagrams the dotted lines could be replaced by ropes or cords, while the full black lines are obliged to be iron or wooden posts or braces.

You thus see that we have the simplest form of a framed truss. This form of truss is called the king-post truss. Now, as the width of the opening increases, the height of the posts would also have to increase, and in a very short time would get so high, and make the inclined braces so long, as to become unwieldy. In order to overcome this, after a certain height has been reached, instead of continuing the king-post higher, we simply cut it off and substitute two posts or rods in its place (Fig. 12). In this the



QUEEN POST *Fig. 12*

length of span that can be covered with the same sized material is one half larger, and the bridge is divided into three panels, as they are called. A panel is one of any number of equal parts into which the truss of a bridge is divided by means of the posts or rods. This second truss is called the queen-post truss; here also the full black lines are in compression and the dotted lines are in tension. As you will notice in this truss, which is also the case in

the flanged girder, the top part of the truss and the top flange are always in compression; so the lower chord is always in tension, as the lower flange in the flanged girders. This principle is the same in all framed girders.

Fig. 13

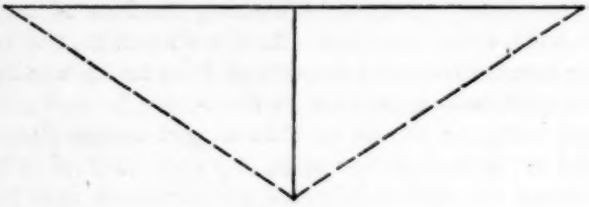
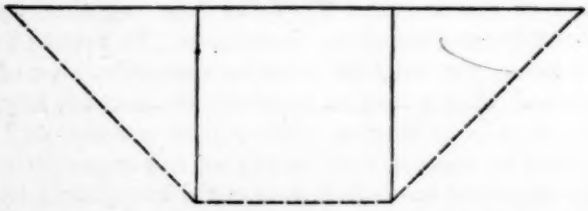


Fig. 14



Either of these trusses can be inverted whenever it is desired, so that the truss comes below the floor, as shown in Figs. 13 and 14; the only difference that it makes is in the character of the strain that comes upon the different members of the truss. The

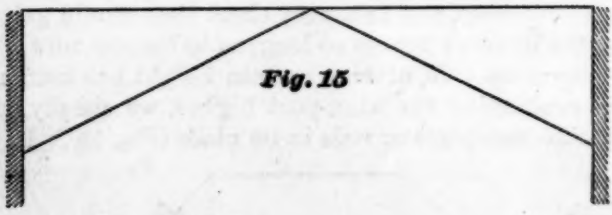


Fig. 15

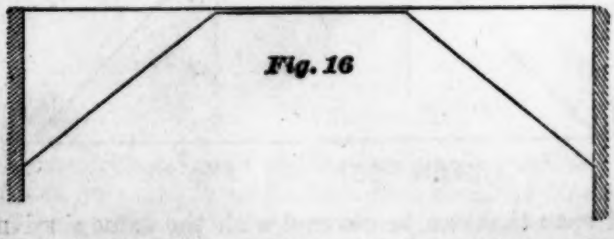


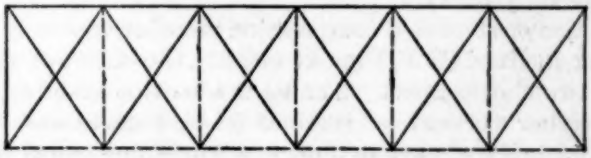
Fig. 16

vertical member in the upright truss is in tension, and when the truss is inverted it is in compression, as shown in the drawing. The braces become ties, and the floor stringers are in compression.

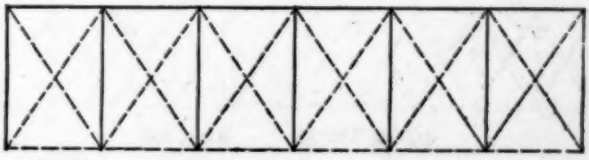
Whenever it is desired to make the floor come upon the top of the truss, then the bottom chord or tie-rods can be omitted entirely, and the horizontal thrust taken by means of the masonry

abutments (Figs. 15 and 16). There the weight comes directly down from the top of the bracing, and the lower end of the braces are held in place by the masonry abutments.

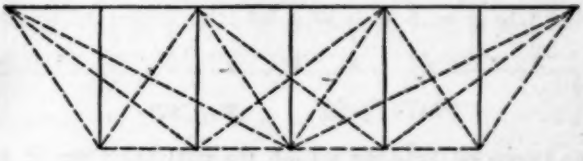
From some combination of these trusses can be constructed any form of bridge, with the exception of the suspension bridge and the arch. By increasing the number of panels or by combining a number of king-post trusses (Figs. 17 and 18), we have what is known as the pony truss, and for short spans one that is used to a great extent on all railroads.



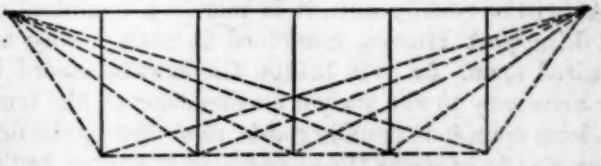
PONY TRUSS. *Fig. 17*



PONY TRUSS. *Fig. 18*



FINK TRUSS. *Fig. 19*



BOLMAN TRUSS. *Fig. 20*

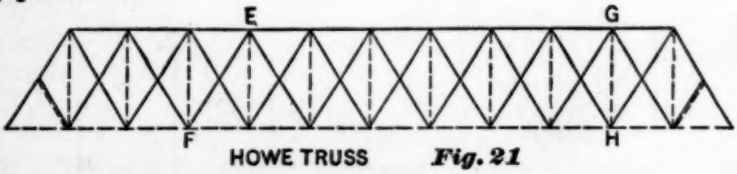
Every bridge is composed of two or more trusses. The ordinary railroad bridge is composed of simply two trusses, one upon each side. These trusses are connected at the top and bottom, and the train can either run over the top of the bridge, or through the bridge on the bottom chord.

In the pony truss, the only distinctive feature is that the trusses are not deep enough to allow of their being fastened together across the top, when the train runs through upon the bottom chord, and therefore they can only be used for very short

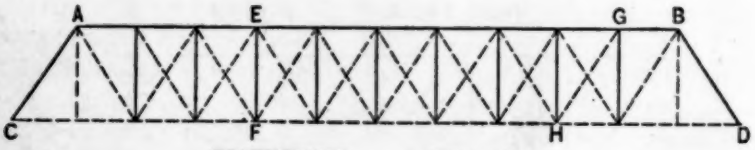
spans, and it is considerable trouble to so brace them as to keep them in a true vertical plane. These pony trusses, however, when used as a deck bridge, that is, when the train runs on the top, can be braced so as to form a very firm bridge, and practically it is simply a box girder (Fig. 5).

The members of a bridge at the top and bottom of each truss, either horizontal, inclined, or curved, are called chords; that at the top is called the top chord (A B, Fig. 22), the bottom one, the bottom chord (C D, Fig. 22). In the bridges we are considering, they are usually parallel.

The brace or strut is a compression member, and may be either vertical or inclined (E F, Figs. 21 and 22), the object of which is to keep the two chords apart. The tie is a tension member, and also may be either vertical or inclined (G H, Figs. 21 and 22). The lower chord being always in tension is sometimes called the straining piece.



HOWE TRUSS *Fig. 21*



PRATT TRUSS *Fig. 22*

In some types of bridges which we will take up at once there is no bottom chord (Fig. 19). We have what is called the Fink truss. As will be readily seen, it is merely a combination of the inverted king-post trusses, combined in such a way as to suit any required span. In this bridge the bottom chord is not in any way necessary to the proper construction of the truss, but in case of a long span it is usually put in as shown by the dotted line, not in any way to increase the strength of the truss, but simply to add to its stiffness and stability. The Fink truss was invented by Albert Fink, and manufactured for many years by the Louisville Bridge and Iron Company. For short spans, or what are usually called shore spans in many-span bridges, it is a most convenient and economical method of construction, and has been very much used. The top chord is in compression, as shown in the drawing, and is usually made of wood, although this is not by any means necessary. The posts, or vertical compression members, are usually of iron, and the tension members consist of round iron rods, fastened by means of an eye and pin at the ends.

The next form of truss is that known as the Bolman truss (Fig. 20). In this also, as in the Fink truss, there is no bottom chord necessary. The distinctive characteristic of the Bolman truss is that from the lower end of each vertical compression member the tension members run directly to each abutment, differing in this respect from the Fink truss, where most of the tension members run across simply one or two panels of the bridge. In this way any load coming upon the top of one of the panels in the Bolman truss passes down the vertical compression member and is at once carried to the abutments by means of the tie-rods. Theoretically, this bridge is one of the most simple that can be constructed; but when the span becomes of any great length, the length of these tie-rods becomes so great as to render them unmanageable, and within very small limits they become impracticable for that reason. Hence, the Bolman truss has not been used to any considerable extent. By the addition of the bottom chord to support the floor timbers of the bridge, either the Bolman or the Fink bridge can be used as a through bridge as well as a deck bridge, although to achieve the utmost economy in their use they are both eminently deck bridges.

We will now take up the different kinds of trusses that are used in ordinary railroad work, all of which are simply some combination of the king-post trusses, either upright or inverted. The first and most common form in this country is what is known as the Howe truss (Fig. 21). In this the braces are diagonal and the tension members are vertical.

This form of truss has probably been built a hundred times more than any other form that is in use. It is not in every respect an economical truss; but the reason of such general use is the fact that it is one of the most simple to construct. The full lines are those in compression, and are usually built of wood. In the Howe truss, the lower chord, which is in tension, is also built of wood, while the only iron-work about it is the vertical rods and cast-iron blocks for the ends of the post. You will thus see the advantages of this truss in a country where wood is very plenty and iron is scarce. The construction of the iron-work is very simple, and the parts are in pieces, so that they can be easily handled by one gang of men with the ordinary block and tackle. The angle blocks are all duplicates, so that, after a pattern has once been made, a great many similar pieces can be made from it; and this, in the absence of skilled labor or proper shops for doing bridge work, is a great saving of time.

In all Howe trusses a very large "factor of safety" has to be used in order to take into account the uncertain character of the wood. By a factor of safety we mean this: you have a given load which is to be supported by a bridge; if all the material

used in that bridge were absolutely perfect, the size of each piece would have to be exactly large enough to bear its part of the strain, and no larger; but as neither in iron or steel, and particularly in wood, can you calculate just exactly how many pounds of strain any particular piece will stand, in order to make it perfectly safe you use, in calculating the size of the bridge members, the load it is to bear multiplied by five, and sometimes even by ten, and then make the bridge theoretically strong enough to hold up this load—that is, five or ten times the amount of load that ever can come on it—and this five, or ten, or six, as the case may be, is called the factor of safety; that is, if all material used in the bridge were absolutely perfect, the bridge would hold up five or ten times as much as ever would come upon it; and wherever a great deal of wood is used the factor of safety has to be very large, as the amount of strain that wood will bear is very uncertain, and varies under different circumstances.

You will readily see that the Howe truss can be used either as a deck bridge or a through bridge, and remember that the Howe truss is the type of bridge that was generally used upon railroads so situated that wood was plenty and iron expensive, and without money enough to send a long distance for iron bridges; and there have been some remarkable examples in this country of the durability of Howe-truss bridges designed by ordinary carpenters without any technical education.

As the price of iron decreased, in a very short time the lower chord of the Howe-truss bridge was made of iron instead of wood, as it was found to be much more economical, and it was then what is called a "combination bridge"; that is, of wood and iron.

The next form of bridge is what is called the "Pratt truss" (Fig. 22). The distinctive feature of this is that the compression members are vertical, while the tension members or ties are inclined or diagonal. In this, the amount of iron, supposing the tension members to be of iron and the compression members of wood, is increased and the amount of wood is decreased. This was a very natural result as the price of iron decreased. In a short time the wooden posts were removed and iron posts substituted for them, and we then have an entire bridge of iron, in which the compression members are vertical and the tension members inclined, and it is the most generally used form of iron bridge in this country; it may be called the typical American railway bridge.

The next form of truss that we will examine is what is known as the Warren triangular girder (Fig. 23). You will see that each of the pieces connecting the upper and lower chords acts both as a tie and a brace—that is, is subject to both compression and tension. The only advantage that can be claimed for this bridge

is simplicity and a fewer number of parts than any other form of bridge truss; but by thus reducing the number of parts we have increased the size of the parts that are used, and thus, to some extent, done away with the advantage. Each of the tie-braces, as they are called, crosses one panel, and the bridge is thus divided into bays two panels long. The vertical rods, as shown in the drawing, are not in any way necessary to the theoretically proper construction of the truss, but are simply put in to support the chord between the panel-points and make it able to bear the cross-strain that comes upon it from the floor system, provided the bridge is a through bridge. When the bridge is used as a deck bridge and the floor system laid upon the top chord, there is the same necessity for vertical posts.

WARREN TRIANGULAR TRUSS *Fig. 23*

In countries where it is possible to procure good timber of large size, the Warren triangular bridge is as economical and convenient a form of truss as can be built. To use it in its most economical manner the lower chord is usually made of iron, as that simply has to withstand tension; but the tie-braces are made of wood, and also the top chord. One point which is to be studied carefully in the Warren triangular truss is the fastening of these braces, as they must be fastened in such a manner that they not only will resist compression, but also that they will act as ties and resist tension. This necessitates a rather more complicated method of fastening.

Another great advantage connected with the use of the triangular truss is the ease with which, when necessary, any piece can be removed and replaced by a new piece without in any way impeding the passage of trains over the bridge during the operation. In the case of wooden or combination bridges this becomes a matter of great importance, as the timber in these bridges is exposed to alternate dryness and moisture, and thus, in a comparatively short time, decays, and there soon is the necessity of replacing the bridge piece by piece; therefore any bridge that is constructed in such a manner as to make this possible, without impeding the traffic on the road, possesses a great advantage over other forms of bridges. The triangular truss is a favorite method of construction on all railroads in the southern part of this country running through that belt where it is possible to obtain, at comparatively slight cost, yellow pine for the requisite timber.

We come next to the last type of bridge that has been used, to

any great extent, upon the railways of this country. This bridge is called the Post bridge (Fig. 24), taking its name from its inventor. The characteristic features are that the compression members are inclined at what is claimed to be the most economical angle—that is, the most economical in regard to the amount of strength obtained for the amount of material used. They are

POST TRUSS *Fig. 24*

so inclined as to cross one panel of the bridge, while the tie-rods, running at an angle with the braces, cross two panels. This is the only advantage that can be claimed for this form of truss, and much of this so-called advantage is more than counterbalanced by some of the difficulties encountered in the actual construction; and whether the bridge really in itself is a more economical bridge than the Pratt, yet remains to be practically proved.

We stated in the beginning that bridges consist of arches and suspension bridges as well as framed trusses. The relation be-

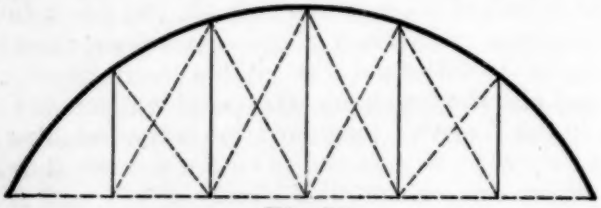
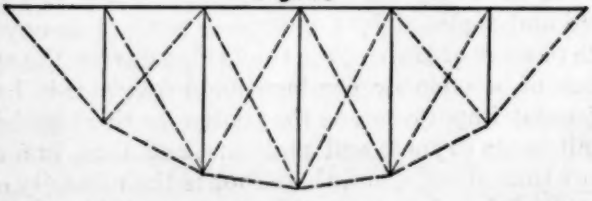


Fig. 25

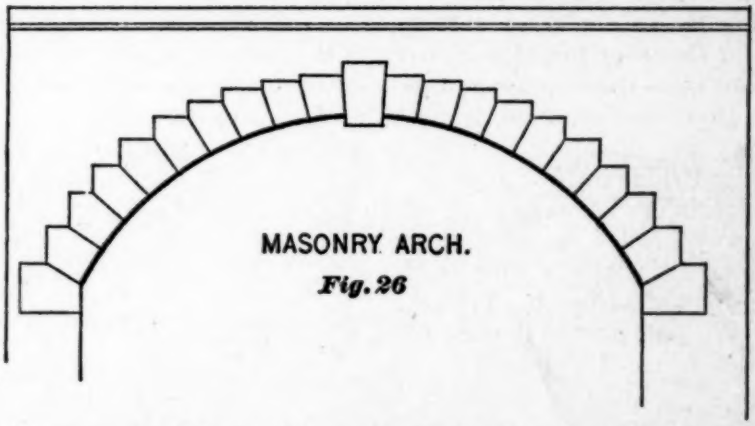
BOWSTRING GIRDER.

Fig. 27



tween the framed truss and the arch will be readily seen by an examination of Fig. 25. Take a truss of the Pratt pattern; then, in place of having the top chord parallel with the lower chord, let the compression members be increased in length, as shown in the drawing, and the top chord take the form of an arch, and we have the bow-string girder. The ends of the arch on each side are simply held together by means of the lower chord, which acts as a tie-rod upon them.

Now, in the case of a masonry arch (Fig. 26), which has the weight all on top, there is no necessity for the tie-rod to hold the ends of the arch together, for the reason that the ends of the arch are always built so as to abut against heavy masonry which will withstand the horizontal thrust, and thus without the intervention of any tie members we have a perfect bridge by means of the

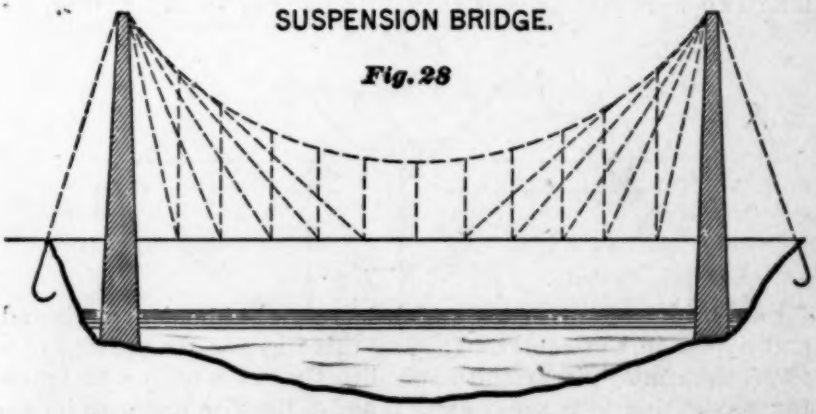


MASONRY ARCH.

Fig. 26

arch, all the weight coming upon the top being passed from one stone to the other in the arch until it reaches the two abutments the same as in a framed truss.

The suspension bridge (Fig. 28) is nothing more or less than the arch turned upside down. In the arch, as we have seen, the



SUSPENSION BRIDGE.

Fig. 28

only strain that comes upon it is compression; in the suspension bridge, on the other hand, the only strain that comes upon the sustaining member or cable which is stretched between the points of support is tension. In the arch bridge all the weight comes above the arch and presses down upon it; in the suspension bridge all the weight comes below the suspension chains and simply

hangs from them. In the suspension bridge the cables, chains, or any other flexible devices are stretched between the two points of support, the ends carried over the tops of the towers, and firmly anchored in the ground beyond. Then the roadway of the bridge is simply hung by tie-rods from this suspension cable.

The suspension bridge is undoubtedly one of the oldest forms in existence. At the time when our ancestors were either swimming across creeks, or cutting trees, making them fall across in order that they might walk over on them—that is, one thousand years ago—the Japanese were building suspension bridges which are in use to-day, using iron chains for suspension cables, and in every way building them in as scientific a manner as the East River Bridge in New York is built to-day. Of course, there was a certain crudeness as to the methods which were used, but this in no way affected the scientific principles on which the bridges were built. It is not our purpose, however, in this paper to take up the question of suspension bridges.

We pass now to the last form, and in this country at least the latest form, of the framed truss—that is, the cantilever bridge. The object of the cantilever bridge is to make possible the economical construction of long, clear spans of a rigid truss, and thus do away to a great extent with the necessity of suspension bridges, as there are many disadvantages besides the mere one of expense that are connected with the use of suspension bridges. The other advantages of the cantilever will be taken up later.

To show the development of the cantilever bridge, we will take two king-post trusses (Fig. 29); putting them together, we

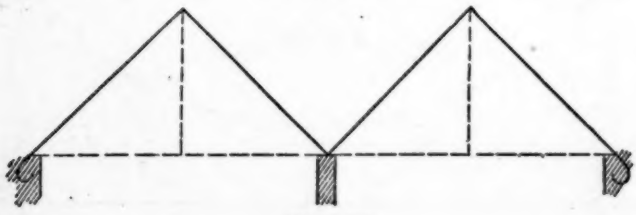


Fig. 29

form a bridge of two spans, which has an abutment at each end and a pier in the center. In case this was for the passage of a river, the center pier would come directly in the center, obstructing navigation to a great extent, and otherwise prove an inconvenience. We use the king-post truss merely as the most simple form of truss that is built. In any other form that could be built the result would be the same; that is, for a bridge of two spans there would be a pier in the center of the river, and for any span that could be built of any of the types of bridges which we have noticed thus far the amount of open space that would be left in

the center of the river may be less than that required by navigation, so that, from what we now have, our only remedy would be the use of the suspension bridge.

In order to do away with this, and make a wider opening in the center of the river, suppose we take away the center pier and replace it by two piers directly under the king-posts of the truss (Fig. 30). In this way we see we have left a large, clear span in

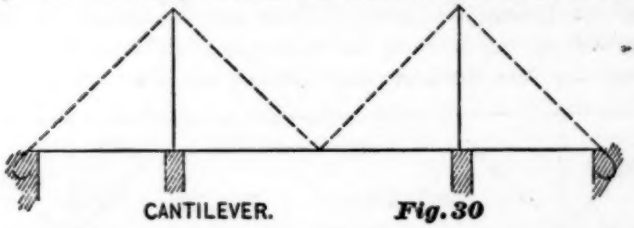


Fig. 30

the center of the river, and we have in no way increased the amount of material necessary for the building of the bridge, and the two spans that we are using are now balanced, each upon the top of its respective pier. These two spans are fastened together in the center, and the shore ends of both are anchored firmly, in order to keep them from tipping up whenever a load comes upon the river end. We thus see that we have doubled the clear span in the center of the river, and we have what is called a cantilever bridge; that is, a truss supported at one end, and extending out over an opening, there being no support under the other end.

Now, suppose it was desired to make this center opening still larger, we have simply to move the piers apart (Fig. 31). We

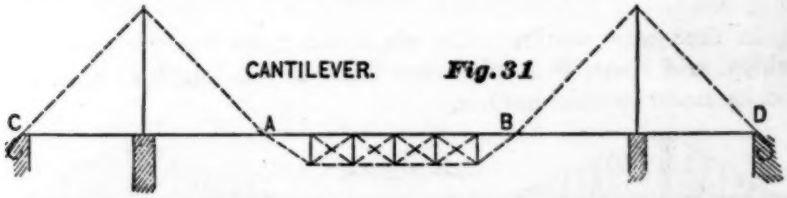


Fig. 31

have our two cantilever spans. The shore end of each is firmly anchored down, and the two other ends, A B, project simply into space. If we build thus, the two ends, A B, are firmly fixed and can not in any way yield to the load that may come upon them. If we now construct an ordinary framed truss, of either the Howe, Pratt, or any other type, and instead of putting this truss upon two piers or abutments we simply hang it between the two ends of the cantilever spans, A B, which are projecting over the river, the weight of this truss will be sustained by the tie-rods from the king-posts, or in the case of the cantilever that run over the tower and are anchored down upon the other side. We thus see that by increasing very slightly the amount of material used

in the construction of the bridge we have an open, clear span in the center three times the width that would be possible with the ordinary framed truss, and we have what is known and has lately become famous as the cantilever bridge. The spans C A and B D are called the cantilever spans, and A B the suspended span.

The variations in the cantilever bridge are almost infinite, although the principles in all of them are the same. In the place of using the upright truss, for example, this truss can be turned over, and the ties then become braces, the floor comes upon the

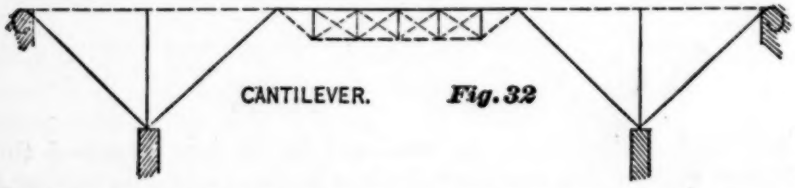


Fig. 32

top, the shore ends being firmly anchored in place, and, the suspended span held in place, we have a cantilever of the type that has just been erected across the Hudson at Poughkeepsie (Fig. 32), while the first example given you is the type of cantilever that crosses the St. John River at St. John, New Brunswick (Fig. 31).

Then, when a greater length is desired and increased strength, as in the case of the bridge across the Frith of Forth, in Scotland, we simply combine the two, putting the two king-post trusses base to base, and hanging the suspended truss between (Fig. 33).

In that way we have the strongest form for the cantilever bridge, and there is hardly any limit to the length of span that can be made by this method.

Fig. 33

The advantages gained by the use of the cantilever for long-span bridges are as follow:

As a substitute for the suspension bridge it is, up to a certain length of span, less expensive, and it can be given great rigidity and stability which are impossible in the suspension.

As a substitute for the ordinary framed truss it has the advantages of not requiring any false works for its erection. In the erection of the ordinary bridge there must be built first a timber frame or staging between the piers to sustain the weight of the

different parts of the bridge while it is being put together. This is a great expense; and in some cases, where the bridge is far above the water, the current very rapid, or an existing necessity of not obstructing the water-way, becomes impossible. In the erection of a cantilever, each cantilever span is balanced on its own pier and built out each side from the tower in such a manner as to preserve this balance until the shore ends are anchored firmly, after which the river ends can be extended as far as desired. The suspended span, which is never of extraordinary length, can usually be built directly from the ends of the cantilever spans, and the necessity of false work entirely done away with.

In all bridges of long span that the weight of the bridge itself is by far the greatest load that the bridge has to bear. In bridges of short spans, the weight of the locomotive and train coming upon them suddenly constitutes the greatest load, as the weight of the train is greater than the weight of the bridge itself; but as the size of the bridge increases, its weight increases very rapidly, and the weight of the locomotive and train becomes almost nothing as compared with the weight of the bridge itself; that is, if any of these long bridges are built strong enough to hold themselves up, with a very slight margin of safety above that, there is scarcely any danger of their ever falling from any weight that could come upon them from an outside load. For this reason, in building short-span bridges, the amount of economy that can be exercised in the use of material is very small, as the bridge must be built stiff and rigid, even if this necessitates the using of much more material than the absolute weight of the tender and locomotive that come upon it would demand. For this reason plate girders or flanged girders have many advantages connected with their use for short-span bridges, because the whole amount of material used is comparatively of little value, and extreme stiffness and rigidity are the result; while in the case of long-span bridges, such as cantilever, or any remarkably long bridge, every calculation must be made with the greatest care in order to reduce the amount of necessary material as much as possible, because by reducing the amount of material used the weight is reduced, and that again reduces the amount of material. The factor of safety to be used can be only two or three in long-span bridges, while in short spans it should run up even to ten.

Although cantilever bridges are of rather recent use in this country and in Europe, and much has been written claiming them as an invention of modern times, still, the same can be said of them that was said of suspension bridges—that there at present exists in Japan, built by the order of the Mikado two hundred and fifty years ago, as perfect and scientific a cantilever bridge as any that

are built in this country or in Europe; and in this way, as in many others, the Japanese show that two or three hundred years ago they had advanced to a wonderful degree in the study of applied mechanics and the "strength and resistance of material." The only trouble is, that they stopped advancing for two or three hundred years, and up to ten or twenty years ago were not as far ahead as two hundred years earlier.

In closing, I wish to call your attention for a few moments to some of the differences that exist between the American and English practice of bridge-building, and the causes that have led to these differences. The characteristic difference is in the methods used in joining together the different parts of the bridge. American bridges, as a class, are pin-connected—that is, the different members, when possible, are joined by means of a steel pin passing through holes in the ends of the pieces. These joints are perfectly flexible, and each member is designed to do its own particular work. English bridges, as a class, have "riveted connections"—that is, the members are fastened rigidly together, and each member is designed to act simply as a part of a rigid, inflexible whole.

The causes that have led to this difference are as follow: In the construction of bridges the English engineer started with the flanged girder of cast or rolled iron, or some other form of a stiff beam, and as the bridges increased in size so as to necessitate the framing of a truss, his whole effort was directed toward making that truss as nearly similar to the original flanged or box girder as possible. This led to perfect rigidity at the joints.

The American engineer, on the other hand, had very little or no iron and steel to work with, and of necessity used wood. As the necessary bridges were of considerable span, the only possible solution of the problem was the pinning together of small pieces of wood so as to form a connected series of triangles. The joints in wood could not easily have been made rigid, and it was not desirable that they should be, as the strength of wood is very slight when the strain is applied in any direction other than in the direction of the fibers of the piece, and the use of the pin joint, theoretically at least, insures this line of action. There has been much ingenuity displayed by our engineers, in the years gone by, in the combinations of triangles used in bridge-designing, and in many cases this has led to absurdities. The whole tendency, however, at present in American practice is to extend the use of riveted joints, and in English practice to extend the use of the "pin connections." Both are working in opposite directions, but from opposite sides, and therefore toward the same point.

One great drawback to the more general use of pin connections by English engineers is the immense first cost of the plant

necessary to do the work. Our bridges are usually designed and built by the same company, so that the design within certain limits corresponds to the available plant of the manufacturer, and the expensive tools can be used over and over again. In English practice, however, the bridges are designed according to the ideas of the individual engineer, and then some firm has to build them in all their details to correspond with the design. If the construction necessitates expensive machinery and tools, no company would undertake them at any reasonable cost, as there would be very little chance of any other similar design being offered upon which they could use the same tools.

In riveted work, however, the tools required are within certain limits the same, regardless of the details of design. Pin-connected bridges are much more economical for large work than riveted ones; and this fact, taken in connection with the unrivaled facilities we have for doing the work, accounts for the fact that in the building of large bridges American firms can underbid any others, and not in any way lower the character of the work done.*

AGRICULTURE AND THE SINGLE TAX.

By HORACE WHITE.

I.

IN the second half of the eighteenth century there arose a school of thinkers in France to whom, at a later period, J. B. Say gave the name of physiocrats. The founder of the school was François Quesnay. Turgot was one of his disciples, and was the most distinguished member of the group. De Gournay, the elder Mirabeau, Morellet, and Dupont de Nemours are well-remembered names of the physiocratic school. Adam Smith was in Paris in the year 1764, and was much in the society of Quesnay and his friends. The exchange of thoughts among these great men must have been mutually beneficial, but the question that has since been raised and discussed with some heat, whether the author of the "Wealth of Nations" gained more from that intercourse than he gave in return, is a barren controversy.

At that time governmental interference with the business and livelihood of the people was incessant and almost universal, and

* Lattice riveted bridges and double intersection trusses have not been discussed, as their introduction would only have obscured the object of the paper.

In regard to the advantages of the American pin-connected bridges for long spans, we may say that from the most recent data the time required for the erection of the bridge, after everything is ready, is only about one twentieth of that required for the erection of the English riveted bridges.

was generally acquiesced in. The doctrine that money was the only form of wealth was held by nearly all statesmen and traders, and had resulted in the establishment of the so-called mercantile system. The physiocrats taught the contrary of both these conceptions. They held that governmental interference with the gainful occupations of the people was bad for both government and people, since it hindered the increase of wealth and the productiveness of taxes. They maintained that money was not wealth except in a secondary sense, as a tool and instrument of exchange, since all persons who acquire money find it for their advantage immediately to lay it out for other things. These two contentions of the physiocrats constitute their claim to the admiration of mankind.

They had another doctrine by which, as it has turned out, they are now more generally distinguished. They held that land was the only source of wealth, and that all occupations except agriculture were unproductive.

Agriculture, they said, yielded a "net product" over and above the wages of the cultivator during the time he was engaged in producing the crop. This net product went to the landlord, and might rightfully be taken by the Government to the extent necessary to defray the public expenses. They accordingly proposed and advocated the *impôt unique*, or single tax, on the income derived from landed property. The residue of the net product remaining in the landlord's hands after the payment of taxes was, in their judgment, the annual and sole increment of the world's capital and stock in trade for the upbuilding of civilization.

All other trades, such as manufacturing and commerce, were *sterile*. These served as the clerks, the agents, the porters of agriculture. If any of these saved anything from their earnings as the handmaids of agriculture, competition would cut down their gains, so that eventually they would have nothing left over at the end of the year.

Adam Smith agreed with the physiocrats in their views respecting governmental interference with private business, and as to the true character and functions of money. He differed from them as to the "net product." He held that land was not the sole source of wealth, but that all useful labor was to be reckoned, equally with agriculture, among the sources. His answer to the physiocrats is embraced in Chapter IX, Book IV, of the "Wealth of Nations." Notwithstanding an occasional subsequent flicker, it may be said, speaking broadly, that if there ever was any economic conclusion upon which the world had agreed it was that the physiocratic doctrine of net product and single tax was erroneous.

II.

This consensus of opinion held good for something more than a century. In the year 1879 Mr. Henry George published his "Progress and Poverty," in which he revived the single-tax idea with some variations. Mr. George says that he arrived at his conclusions by independent reasoning, without knowing anything of Quesnay or his doctrines ("Progress and Poverty," p. 381). The only practical difference between Mr. George and the physiocrats is that he would take all the "net product" for public use, while they would take only so much as might be required for the purposes of economical government. There are differences of reasoning between them, but this is the only difference in results.*

Mr. George's latest commentator, Mr. Samuel B. Clarke,† allows that the net product may turn out to be a net deficiency as regards the full support of government. In one of his opening paragraphs he says:

"He (George) assumes, without conclusive evidence, that economic rent in the present state of this and every civilized country largely exceeds the amount required for necessary governmental expenses. The assumption, however, is not essential to his scheme. If the amount realized by the proposed tax would not support the Government, of course there would have to be taxes on other things; but the amount to be raised would be less by the amount of the land-value tax."

If we could settle this question of the sufficiency of economic rent to sustain all the costs of government in advance of actual experiment, much would depend upon what we should call necessary governmental expenditures; much would depend also upon what we should take for the basis of economic rent. The latter is defined by Mr. Clarke as "the fair rental value of land exclusive of distinguishable betterments." Buildings, fences, and growing orchards are distinguishable betterments. Perhaps roads and ditches made at the sole expense of the land-owners may be so considered. But are clearing, grubbing, breaking, marling, grading, and like ameliorations distinguishable? If so,

* In the "Forum," September, 1889, Mr. Thomas G. Shearman, one of the most distinguished members of the single-tax party, holds that it is not necessary to push the single tax beyond necessary governmental expenses. The absorption of the entire ground-rent, he says, "is not a practical question at present, and will not be for a long time to come, *if ever*." This marks the recent divergence between Mr. George and the "Standard" on the one hand, and the Rev. Mr. Pentecost and the "Twentieth Century" on the other. With the latter the single tax is a cult; with the former it is now only an economic doctrine, or at most a "pious opinion." But certainly "Progress and Poverty" teaches a cult, if it teaches anything.

† "Current Objections to the Exaction of Economic Rent by Taxation considered," by Samuel B. Clarke, of New York; pamphlet edition, 1889.

we have Henry C. Carey's word for it that no farming district or county or township will sell to-day for as much as it has cost to bring it to its present state of productiveness. I do not agree with Mr. Carey in this. I only mention it to show what a chasm of divergence will open whenever the Government shall undertake to define distinguishable betterments and separate them from undistinguishable ones for the purpose of securing what Mr. Clarke calls "a firm foothold" for the inscribing of the fair rental value of each piece of land in the public accounts. Still, this difficulty may not be insuperable.

I propose to examine Mr. Clarke's pamphlet rather than Mr. George's book, because the former, although drawn almost wholly from the latter, embraces in small compass and with eminent fairness all that is needed to set out the single-tax argument, and does not lure us into by-ways as Mr. George often does.

"Why should land be singled out, and its holder made to bear a burden from which the owners of other sorts of property are exempt?"

This question is answered by Mr. Clarke, first on economical and then on ethical grounds. On economical grounds: "Because (1) material progress in a community where absolute private property in land is maintained by law, acts, by force of that fact, like a wedge thrust midway into the social structure, to raise a few without effort or merit on their part, and to grind down the masses of men, however meritorious they may be; and because (2) property in land being qualified in the way proposed, poverty will be abolished for that increasing class in civilized communities who are willing to work, but have few opportunities to do so advantageously."

We are not authorized to infer from this statement that in a community where absolute private property in land is maintained by law, e. g., the United States, "a few" belonging to the landless class never get unduly elevated, or that land-owners never get ground down, in both cases regardless of merits, or out of all proportion to merits; nor can we infer that in a community where the state is the landlord, e. g., British India,* a few are never elevated and the masses never ground down, regardless of their merits respectively. But we may fairly demand that the writer shall point out his "few" before he asks us to accept his statement. Do land-owners in the United States get rich faster than other people? To say that the Astors are very wealthy, and that they

* De Laveleye, in his work on "Primitive Property," gives the reason for holding that the state is the real landlord in India. "Where the land-tax rises so high," he says, "as to absorb nearly the whole produce and to leave the cultivators only the bare means of subsistence, it is obviously an actual rent that is paid; and if it is the state that receives such a tax, it may be considered as the true proprietor."

have their counterparts as land-owners in all our lesser cities, does not answer the question, because the Vanderbilts, the Havemeyers, the Drexels, the Rockefellers, the Carnegies, the Armours, and the Pullmans are also very rich, and they do not own land to any large extent. Can anybody point to a similar group of rich men whose income is derived from agricultural land?

Any man of fair intelligence can answer the question for himself. The opportunity has been open to me, for example, to get rich by land-owning ever since I arrived at man's estate. It has been open to me to acquire land at all prices, from nothing per acre upward. I was once domiciled for a short time at a place where land was obtainable at the former price—good arable land, underlaid by a workable vein of coal. I filed an entry on one hundred and sixty acres of it at the United States Land-Office at Lecompton, Kansas; but, happening to receive an offer of twenty-five dollars per week to work on a newspaper shortly afterward, I abandoned my claim, and I am sure that I made no mistake in the point of view of dollars and cents. I took up my abode in the city of Chicago when there were only sixty thousand inhabitants there. The growth of that place has been, since that time, one of the remarkable phenomena in the world's history, and a great part of this growth took place under my eye; yet I have never seen the time when I thought I could make better use of my small capital by becoming a land-owner than by following other pursuits. But I have had some experience as a land-owner. The land that I have at one time and another owned, whether urban, suburban, or agricultural, or taken altogether, has not served me as well on the whole as other investments.

I make this personal reference because I know that my experience tallies with that of many others. Mr. Henry George, for example, has fairly earned all that he possesses of this world's goods. I venture to ask whether the same amount of labor, diligence, and foresight that he has bestowed upon his own vocation of book-writer, journalist, and publisher, if applied to the acquisition and use of land, would have netted him as much. Undoubtedly both he and I, by the use of hind-sight, can see where we might have made larger gains by becoming land-owners than we have ever made. But so, too, by the use of hind-sight we can see how we might have made as much or more in still other ways. We might have invented a telephone, for example.

Before proceeding it should be noted that Mr. Clarke expressly repudiates the idea that the single-tax argument rests upon the idea of an "unearned increment." The rise in land values due to the growth of population has nothing to do with it, or at most only serves to set it in a more glaring light.

"The argument for the land-value tax" (he says) "is very apt

to assume the form, and, if we may judge from current criticism, is quite generally understood to have the form, that because the value of land increases without effort on the part of the landholders as the community grows, therefore the community has earned such value, and may justly take it for common purposes. In that form the argument is fallacious beyond question."

Land, he shows, is subject to decrease as well as to increase of value, and other kinds of property increase or decrease in value quite independently of the owner's exertions, merits, or demerits.

The second economical reason why land should be singled out and its holder made to bear a burden from which the owners of other sorts of property are exempt, as stated in the quoted paragraph, is "because property in land being qualified in the way proposed, poverty will be abolished," etc. No mode or process by which poverty is to be abolished being furnished, we are at liberty to infer that, if a marked addition were made to the land-tax all over the country, the poor would soon find themselves in easier circumstances; and that if successive additions were made, they would become more and more prosperous; and that when the whole rental value had been taken, there would be no poor people anywhere.

Now, taxes on land are paid by land-owners (I believe that Mr. George agrees to this). The proposition then is, that if land-owners were required to pay into the public treasury as much as they could by any possibility pay, other people would be so much benefited that even the poorest people in the world would be in comfortable circumstances.

The only way that this great change can be brought about is by the abolishment of all other taxes. I do not undervalue the relief that would accrue to industry from the abolition of indirect taxes. I hold that it should be the first step toward the elevation of the poor man, and the bettering of his condition, to let him have and enjoy what he earns—all of it, except just sufficient to keep him watchful of tax-eaters and tax-thieves.

But suppose that Divine Providence should bestow upon us rulers who could carry on government without any taxes whatever. Would that dispensation abolish poverty? Those who think so are bound to tell us how.

The single-tax philosophy does not propose to constitute a fund for general distribution. If anything should be left over after defraying all necessary expenses of government, the residue is to be applied to the common benefit and delectation through free libraries, music halls, picture galleries, higher education, etc. There is to be no alms-giving, because there are to be no poor. I take it that the utmost good to be derived from the exemption of all others than land-owners from taxation would be gained equally

by any device or dispensation which should enable government to be carried on without taxes. I protest against the assumption that this would abolish poverty, unless those who hold that it would shall offer us something more conclusive than their private opinions.

III.

The ethical reason why land should be singled out exclusively for purposes of taxation is based upon what are called "natural rights." I quote Mr. Clarke's words:

"The second answer, in substance, is: Because land is not rightfully the subject of absolute property, and because the injustice of allowing it to be so acquired and held will be remedied by the exaction and application to common uses of economic rent.

"The standard of right, to which this answer appeals, is that conception of inherent or underlying rights which is usually described, perhaps not altogether happily, by the phrase natural rights."

General Francis A. Walker, in his "Land and its Rent," disposes of the dogma of natural rights as applied by Mr. George with a few words of sarcasm, which really do embrace the true philosophy of the subject. He says that as he has never lived in the state of nature himself, but has passed his whole life in communities more or less civilized, he does not feel moved to discuss the subject on any other than economic grounds. According to my observation, more people of fair intelligence are taken in the single-tax net by this dogma than by all others together; and even when they are shaken from every other, they still cling to this as a sheet-anchor. It is worth while, therefore, and indeed necessary, to give some particular attention to it, in an elementary way.

Having cautioned us against the use of the phrase "natural rights" as not altogether happy, Mr. Clarke proceeds to use it twenty-one times in the next twenty pages, as though it were as happy as possible, assuming in all cases that every person born into the world has a natural right to land and a natural right to the best land—conditioned, however, upon every other person's equal right to the same land. The only way to make these conflicting natural rights effective is to confiscate economic rent through the taxing power.

What are "natural rights"? Let us test them for a moment by the Socratic dialogue, the interlocutors being A and B:

A. When you speak of natural rights, you mean rights according to nature, I suppose?

B. Undoubtedly.

A. And that the origin of such rights is traceable to the state of nature?

B. Certainly.

A. What would be the opposite of a state of nature, regarded as an origin of rights?

B. Art, convention, agreement, law.

A. Then the opposite of natural rights would be artificial, conventional, and legal rights?

B. Not the opposite exactly, but the counterpart and supplement of such rights.

A. But as to their origin only, you would say that the two origins were opposite to each other, the one being according to nature and the other not according to nature?

B. Yes, that would be a fair statement.

A. How do we learn whether anything is according to nature, so as to distinguish it from things not according to nature?

B. By observing what takes place in a state of nature.

A. So, if we saw a wolf devouring a sheep in a forest, we should say that it was the nature of wolves to kill sheep?

B. Of course.

A. But if we saw a dog guarding a flock of sheep and driving them into a sheep-fold at night, should we say that it was the nature of wolves to kill sheep, but the nature of dogs to protect them?

B. No, we should say that the dog had been trained to take care of sheep, although his ancestors had themselves been sheep-killers.

A. Why should we say this?

B. Because we know it by observation and testimony.

A. Do observation and testimony teach us that in a state of nature all men have equal rights?

B. We do not know exactly what is the state of nature applicable to man, since he has improvable faculties and is always changing, or is susceptible of change.

A. Yet the hypothesis is that equal rights are according to nature—that is, to man's nature. Are we to say that natural rights exist because there is no state of nature for man, as there is for dogs and wolves?

B. Although man has improvable faculties and is susceptible of change, and although his actual state of nature is hidden from us in the darkness of ages, before written language existed, yet it is possible to approximate toward the state of nature by observing what takes place among those tribes that are nearest to the state of nature.

A. And do we observe that among such tribes equal rights exist as to life or liberty, or any kind of property?

The colloquy would "naturally" come to an end at this point, because, in a state of nature, might makes right. The natural man takes what he wants, wherever he can find it. He takes the

weaker man's wife or property, and kills or enslaves him, as the case may be.* It is safe to say that this has been the state of man in all countries "ere human statute purged the gentle weal."

The village community, in which the land was held in common for the villagers (not for everybody), was the outgrowth of law, of art, of convention; but even this was subject to the law of the strongest, in the sense that every village community was liable to be dispossessed by any wandering tribe better armed, or more numerous or braver, that might suddenly emerge from the neighboring forest or mountain. The feudal system displaced the village community because the village could not protect itself against armed robbers.†

The recent searching examination of "natural rights" by Prof. Sumner ‡ renders it unnecessary for me to go more deeply into this branch of the subject. What are commonly and loosely called natural rights are the outcome of centuries of hard knocks, the results of training, education, and experience, *the very flower and last refinement of art as applied to society and government.* Mr. Clarke cites certain decisions of the Supreme Court to show that natural rights have "their seat in the bosom of God and their voice in the harmony of the world," to quote from Hooker's definition of law. But all such opinions are *obiter* to this discussion. That *our* ideas of natural rights, civilized though we be, change greatly in the progress of time, is proved by our own recent history, the right to liberty having been denied by a majority of Americans within our time.

Conjoined to the doctrine of *natural* rights, though not a necessary part of it, is the doctrine of *equal* rights, which I share as fully as anybody. But, if I attempt to draw generalizations from it, I am confronted by the fact that it is not universally held, but is really confined to a small portion of the human family. The

* The movement now in progress for the suppression of the African slave trade has shed an abundance of light (if any more were needed) on the subject of "rights" as they actually exist in the state of nature. The prime difficulty there is not Arab slave-dealing, but the practice prevailing among the native tribesmen of enslaving each other for the purposes of human sacrifice in their religious ceremonial. Arab slave-dealing is not the cause of African slavery, but merely an adjunct to it.

† "Not to be killed," says Stendhal, "and to have a good sheepskin coat in winter, was, for many people in the tenth century, the height of felicity"; let us add, for a woman, that of not being violated by a whole band. When we clearly represent to ourselves the condition of humanity in those days, we can comprehend how men readily accepted the most obnoxious of feudal rights, even that of the *droit du seigneur*. The risks to which they were daily subject were even worse. The proof of it is that the people flocked to the feudal structure as soon as it was completed. In Normandy, for instance, when Rollo had divided off the lands with a line, and hung the robbers, the inhabitants of the neighboring provinces rushed in to establish themselves. The slightest security sufficed to repopulate a country. (Taine's "Ancient Régime.")

‡ "Popular Science Monthly," July, 1889.

Hindus, for example, hold that rights ought to be apportioned according to caste. In the Mohammedan world the doctrine of fate completely overtops and stifles the doctrine of equal rights. A considerable portion of the human race hold that women have no rights. A majority of the civilized races hold that woman's rights are inferior to man's rights, and we ourselves do not consider them embraced in the term "popular sovereignty." Yet they are one half of the human race, and the more meritorious half.*

I shall assume, without further argument, that the rights of life, liberty, and property, including land, all rest upon *experience*, translated, after infinite trouble, conflict, and bloodshed, into *law*, and this notwithstanding any opinions of the Supreme Court that can be quoted to the contrary.

A title to anything, land or personal property, is defined to be "a just cause of exclusive ownership," and a title-deed is the accepted evidence of the same. The law tells us what shall constitute just cause of exclusive ownership and what shall constitute good evidence of it. It is the same law, as to its origin, that fixes, prescribes, defines, and enforces all rights.

The law has prescribed in this country the following among other things: (1) That human life shall not be taken except in self-defense or by due process of law; (2) that private property shall not be taken for public use without just compensation; (3) that slavery or involuntary servitude shall not exist except as a punishment for crime—this is placed last because it was enacted last.

On the ground of *salus populi suprema lex* the state holds command over the lives and fortunes of its citizens, and to this sovereignty land forms no exception. The state may draft the citizen into its army or navy, and send him into battle where he may be killed. It may likewise take his landed property or his personal property. It is the sole judge of the occasions and the reasons. But it must act in accordance with its own constitution. It must not arbitrarily choose A, B, and C to go to the wars. It must not take private property without just compensation. If it does these things, it subverts itself and plunges into chaos.

There is no peculiar sacredness about land titles as distinguished from other titles. If the annual tax on land is not paid,

* Jeremy Bentham has given an analysis of the phrases in common use which are synonymous with law of nature, such as moral sense, common sense, law of reason, natural justice, natural equity, and fitness of things. "Common sense," he says, "means a sense of some kind or another which the author affirms is possessed by all mankind; the sense of those whose sense is not the same as his being struck out of the account as not worth taking. . . . If such a man," he adds, "happens to possess the advantages of style, his book may do a considerable deal of mischief before the nothingness of it is understood." ("Principles of Morals and Legislation," chap. ii.)

the title is subverted at once. So, too, if a special assessment, or a mere water rate, is not paid, the land is sold, and a new title delivered to the purchaser, and this happens even if the non-payment is the result of accident. Personal property is liable to seizure and sale in like manner, and this is right, because the state must have the means of existence. All persons have had notice that such are the conditions of civilized life, the alternative to which is the feudal system, or the worse condition that went before it.

When we are told that the state could not divest itself of the right to resume possession of the land, we reply that it never has done so. It has only divested itself of the right to take it without just compensation. If any casuist puts himself back of the contract, and says it was wrong in the beginning and void *ab initio*, he has before him the immense task of turning the world over without a fulcrum; for the world, after an incalculable deal of shifting and balancing, has settled down to the belief that agreements made in writing should be kept.

Suppose we admit that there are two sides to the question, and that it is submitted to a jury from the moon. A holds that private property in land is a disadvantage to society, and should therefore be abolished without compensation to owners. B holds that it is an advantage to society, independently of constitutions and laws, and he shows in addition that a solemn agreement has been made that it shall not be abolished without compensation. Both advance such arguments as they may. A says (using the words of Mr. George in his speech at Brighton Beach, July 28, 1889):

"So monstrous is private ownership of land, so unjust is it—so ridiculous even is it, that a few men should be the owners of the element on which and from which a whole people must live—so clear is it that all men have by nature equal rights to the use of the land—that private property in land as we know it can only long continue where from the *force of habit* it is acquiesced in and never questioned. When it is thought about, when it is talked about, even when it is defended, it is doomed."

B replies that "force of habit" is another name for human experience, and that it has stronger presumptions in its favor than anybody's inner consciousness; that the usefulness of land resides in its cultivation, and that no man can show from inner consciousness that better, or as good, cultivation would result from the abolition of private ownership; and that, if worse cultivation should follow, the whole human race would be sufferers. Would not the men from the moon say: "Gentlemen, your arguments are somewhat confusing. We perceive that private ownership of land, like most of your institutions, has advantages and disadvantages; but there is one fact about which no confusion exists,

and that is, that men ought to live up to their agreements. We accordingly give our verdict to B. And we do this with the more confidence because we believe that, when the disadvantages become clearly preponderant, you will find a way to overcome them without shocking the moral sense of distant observers."

IV.

Are the taxes on land in this country high enough or not? Is economic rent sufficient in amount to support government? We will consider these questions in their relation to agriculture.

The generally received idea of the single-tax party is that held by the physiocrats, that all wealth proceeds from agriculture, using that term to include all the products of the earth and the sea. This is a corollary of Mr. George's book, although I believe he has not explicitly affirmed it. I find an apt statement of it in the "Twentieth Century" of August 3d, viz.:

"Where all land is occupied, the annual rental value of the land of a nation is, theoretically, equivalent to its net annual production—that is, to the total production, less sustenance, interest, and replacement. This, through private land-ownership, is now all absorbed by a small number of individuals."*

It is needless to say that mere space, which is not applied to the growing or gathering or mining of anything, is not to be included in the wealth-producing parts of the earth's surface, according to the physiocratic conception—such as lots in towns and cities. If all wealth comes from the earth by means of agriculture, mining, hunting, and fishing, why should not they pay all the expenses of government and a fund besides for the general use? Would not those industries, after such deductions, still be as well off as the industries which have no share in the land? Is not the whole of a thing equal to all of its parts?

It is true that man draws his sustenance from the earth, and that the annual surplus which takes the form of capital, of whatever sort, there has its start. But where does agriculture begin and end? It is commonly supposed to begin with the making of roads, the clearing of land, and the destruction of beasts of prey. But, before land can be cleared, tools must be made. Axes, plows, spades, wagons, bows and arrows, gunpowder perhaps, must be manufactured. And where does it end? All production is undertaken to satisfy man's wants. These are not satisfied when a bale of cotton has been picked or a ton of wheat gathered into a barn. The wheat must be ground into flour, the flour must be baked

* I do not find any explanation of the word "theoretically," but I suppose that it was not used without a purpose. *Theoretically* a man who owns the only coal mine on the line of a railroad has a valuable monopoly, but it may turn out *practically* that he only has the privilege of working it on terms fixed by the railroad. I can point to cases of this kind.

into bread, the bread must be carried to the consumer. All these processes require labor in countless forms in the production of machinery, buildings, tools, packages, and transportation. The bale of cotton must be packed, carried to and fro, spun, woven, and again carried to and fro. So of every product of the earth, without exception. All industry and all commerce are concerned in changing the forms and places of the products of agriculture, forestry, mines, and fisheries.

John Stuart Mill ("Political Economy," Book I, Chapter II) asks why the grinding of corn should be considered a manufacturing employment, while the thrashing of it is agricultural. The only reason, he says, is that thrashing is usually done on the farm, while the grinding is done at a mill. Butter-making is counted an agricultural employment if it is done on the farm, but a manufacturing employment if it is done at a creamery. But it is the making of the butter, and not the place of making, that is the essential thing. Carry your imagination along all the ramifications of human industry to its farthest confines, and where can you find anything that is not analogous to the two related employments of the milk-maid and the butter-maker? Mr. Mill shows that the labor of astronomers, who help the sailor to find his way by the shortest paths over seas, carrying the farmer's products, is productive labor, and that whether it be called agricultural or not is of no importance to the sum total of the world's wealth. To draw a distinction, therefore, between agriculture and the manipulation and transportation of its products, as a source of wealth and taxes, is false reasoning.

Taxes must be apportioned among political units. The State of Connecticut is one such unit, and I choose this for present consideration because there has been a recent official examination of the profits of agriculture in that State, which enables us to see what economic rent amounts to in one of the most industrious and prosperous communities in the Union. It is embraced in the "Report of the Bureau of Labor Statistics for the year 1889." Mr. Hotchkiss, the commissioner, has sought to make out as good a case for agriculture as possible, to show that it is not in a distressed condition, or not necessarily so. What is the showing of economic rent in Connecticut?

Six hundred and ninety-three farms were visited. Three hundred and fourteen report average profits of $362.88. Three hundred and seventy-eight report an average loss of $268.59. One reports neither loss nor gain. In this calculation the farmer's family support was reckoned as part of the farm expenses, which Mr. Hotchkiss thinks is improper, since, in reckoning the gains of other trades, it is customary to deal only with the profits and losses of the business by itself. Making this correction, he

finds that six hundred and fifty farms make an average profit of $551.36, and that forty-two sustain an average loss of $232.45. The average size of the farms reported on was one hundred and ten acres.

I can not agree with Mr. Hotchkiss that the family expenses ought to be deducted in estimating the profits, unless an allowance is made on the other side of the ledger for wages of the family. The children of farmers begin to work as early as ten or twelve years of age. Therefore, the first cited computation of the profits of farming in Connecticut is the nearer to the truth. The footings, as summarized by the commissioner, are as follows:

Total receipts from six hundred and ninety-three farms	$707,153
Total expenses, including family support	690,990
Total profit	$16,163

Among the farm expenses we find the gross sum of $37,526 set down to taxes and insurance, but there is no separation of the taxes from the insurance. It is apparent that if the gross sum of $16,163 had been added to the tax bills of these farmers, it would have taken not only the whole of the economic rent, but the profits on their capital besides. The statistics in hand lead me to believe that the single-tax theory is already in operation in rural Connecticut, "unbeknownst" to its advocates—that is, that economic rent is wholly taken by the tax-gatherer from agricultural land plus something from the returns of the farmers' capital invested in live stock, implements, and "distinguishable betterments," which the theory requires us to exclude from the list of taxables. Live stock, farming utensils, and wagons are shown in the report to be sixteen per cent of the farmer's capital, the real estate being eighty-four per cent. But the real estate includes buildings of every description, fences, drains, wells, and every kind of improvement.

If this is the true state of the case in one of the most densely populated States of the Union, where shall we look for the revenue that is to liberate all other industry from taxation and abolish poverty throughout the land? I know something about farming in the West, some years of my life having been spent on a farm in a then frontier State, where the conditions were substantially the same as those now prevailing in Dakota and Nebraska. I know that my step-father, the owner of the hundred and sixty acres under cultivation, had hard work to make ends meet in a very economical way, although he had a family of willing helpers. Tea and coffee were luxuries never seen in the household. Only one hired man was ever employed on the place, except in harvest-time. Thus the wages bill was kept down to a minimum.

The yearly tax bill took the whole of the economic rent, if not more, just as it now does in Connecticut. I remember that my step-father was glad to resign his advantages as a land-owner and accept a salary of five hundred dollars per year in a town, in lieu of his chances of being lifted into affluence by "the wedge thrust midway into the social structure," which Mr. Clarke pictures for us. I suspect that Mr. Clarke never worked on a frontier farm.

Between the extreme West and the extreme East I presume that instances of economic rent can be found in farming districts, but my observation teaches me that it is an insignificant affair in the total economy of the nation. When you have swept off all buildings and other distinguishable betterments, all live stock and other personal property, and when you have deducted fair wages, or if you please the family support of the farmer (generally of a very meager sort), the residuum of economic rent, I am very sure, will not be worth the trouble of confiscation.

If the single-tax theory prevails, what shall be done in those cases where economic rent is a minus quantity? According to the Connecticut report, three hundred and seventy-eight farms out of six hundred and ninety-three (fifty-four per cent) report no profits, but losses instead. Should they not be compensated in some way? Would it be fair for the state to take only the choice cuts of economic rent, and leave the bone and gristle? The least that it could do would be to abolish taxes on all land that yields no return to an industrious cultivator. Of course, there are good farmers and bad farmers. Some can make a living where others can not. But when the Government, in addition to all its other duties, takes up the task of separating all the distinguishable betterments of the country from all the land in the country, and rack-renting the land afterward, it will probably stop short of the task of discriminating between good farmers and poor ones. It would be obliged to stop taxing the non-profit-making farmers, if indeed it did not consider them entitled to some compensation out of the treasury for their labor. I do not see how otherwise the single tax would abolish the poverty of these three hundred and seventy-eight Connecticut farmers.

V.

The solidarity and interdependence of useful industry dispose of the complaint that all except land-owners are crippled and curtailed of their chance of earning a living. Says Mr. Clarke:

"A material thing is not rightfully the subject of absolute property if the appropriation of it by the exertion of one man's natural powers interferes with the equal right of other men to exert their natural powers.

"The appropriation of land does so interfere. To test the principle, it will be proper to take for illustration a community like New York or Massachusetts, whose laws maintain private property in land, and in which all the land has been fenced in or substantially so; for such communities are numerous, and, as population increases, will become more numerous. In such a community, obviously, a landless man can not do anything *individually*. He can not obtain for himself food or clothing or shelter or fire; he is dependent upon other men for such alms or for such employment as they are willing to give him."

When the fight against the English corn laws was in progress, it was urged by the protectionists that agriculture was the most meritorious of all employments, because it furnished food, without which man could not exist. I recall the apt reply of General Perronet Thompson, who said that, if you were to throw two men into the street, one without any products of agriculture and the other without any products of manufacture, there would not be much to choose between them. One of them would be hungry and the other naked. But the naked man would very soon be as hungry as the other, because he would have no tools to cultivate the land with, and if the temperature happened to be at zero the naked man would be frozen to death before the hungry man would be starved to death.

Mr. Clarke, I believe, makes his living by the practice of law, and, being a landless man, "can not do anything *individually*." He is "dependent upon other men for such alms or such employment as they are willing to give him." I, too, am in this plight. We two are therefore worse off theoretically than any of the Connecticut farmers whose pecuniary condition has been ascertained for us in the report of the Bureau of Labor Statistics. I say "theoretically," but I suppose that actually the case is somewhat different. If we are dependent on farmers for food, they are dependent on us for law and newspapers. They might get on after a fashion without law and without newspapers, perhaps, but they could not get on without houses, clothing, tools, wagons, railroads, ships, medicines, etc., the producers of which in turn have need of law and newspapers. The only man who can do anything "individually" is Robinson Crusoe. Neither of us would care to swap places with him.

There are other economic formulas in the essay before us as unsubstantial as this, but space serves to notice only one more. The merit or demerit of this belongs to Mr. George, Mr. Clarke having merely condensed what Mr. George has set forth at greater length. It relates to land held for speculative purposes, and the argument is, that the single tax will wipe out this speculative element and thus benefit society. Thus, it is said: "A very great

body of land would become substantially free, and all the people of this country would stand, so far as abundance of natural opportunities are concerned, where their predecessors stood sixty or eighty years ago. . . . Furthermore, the annihilation of the speculative element of value is likely to have a particular beneficial effect in and near large cities, where now the density of population presents a great and terrible and threatening problem, before which, hitherto, all the wisest and most humane of men have stood gasping and helpless." Capitalists, it is contended, would hasten to erect comfortable houses for rent on vacant city and suburban lots "if, from the value of such lots, the speculative element were excluded. Houses would compete for men, instead of men cutting each other's throats, as now, in the competition for houses."

The first result of the application of the single-tax principle would be to discharge from taxation all unoccupied land in both city and country. The value, or rent-yielding quality, having been seized by the state, nobody would be so foolish as to pay taxes on property which neither now nor hereafter could bring him any return. All such holdings would be abandoned to the state, and this is exactly what is intended. Of course, the state would not tax its own property.

Then the state would say to capitalists, "You can build on this land on condition of paying ground-rent, and you will receive such interest on your capital invested in bricks and mortar as the law of competition will allow." But that is what capitalists can do now. By paying ground-rent they can build as much as they please. How is building to be expedited by changing the landlord? In fact, it would be retarded. At present the land-owner is spurred on to improvement by the hope of gaining a ground-rent and by the imposition of a yearly tax on his property, which he must pay whether it yields any return or not. Both these incentives would be wanting if the land were owned by the state.

How would it be with agricultural land held for speculative purposes? The state would say to the would-be farmer, "You can cultivate this land by paying the rent which neighboring land pays." But can not the farmer get the same land now on the same terms? Show me the owner of untilled agricultural land who refuses to allow his acres to be cultivated at a fair rental. I can show plenty of such land within one hundred miles of New York, and all over New England, which any cultivator can have the use of, without paying any rent at all, on condition of cultivating it. Surely the state would not offer land on more favorable terms. It would not let the land, rent free, and furnish the capital to cultivate it also. In short, no new opportunities for the cultivation of land would exist unless the state should offer better

terms than present owners offer. But this the state could not do without sacrificing the fundamental principle of the single tax, which is that the occupier shall pay the full economic rent.

It is the testimony of all observers that, of two men of equal endowment cultivating land, the one being the owner and the other only a tenant, the owner makes the best use of the land, gets the largest crops, has the best cattle and the best orchard, and in all ways takes the best care of the property. The reason is very simple. It is because all the labor, skill, and economy bestowed upon the land enure to his own advantage. The net results belong to him, and this is sufficient reason for the employment of his best powers and for the practice of the utmost frugality. Capital arises from the exercise of industry and frugality. It is for the interest of the state that capital should be created. The system of land tenure which offers the greatest inducement to the creation of capital is the one most conducive to the public interest.

Again, the private ownership of land tends to stability in institutions. The ideas which gather about the word *home* are the most precious, both to the individual and to the community, that we are able to conceive of. A man will ordinarily undergo greater hardships, practice more self-denial, exercise more of the virtues which go to the upbuilding of the commonwealth, in order to secure a *home*, than to accomplish any other object. This is what his mind is first set on, and when he has gained it his efforts are equally enlisted to keep it. The single tax threatens to profoundly alter the meaning of this word as we understand it. It is not consistent with the idea of home that somebody should take it away from us by bidding at an auction. If it be said that no such auction would take place, but that the state would fix the tax at a rate previously ascertained as sufficient to take the economic rent, differing from the present tax only in amount, then we say that there is no means of ascertaining what the economic rent is. It would be possible to form an approximate estimate at the beginning by taking as a standard the rents paid by individuals for the use of land as a matter of bargain. But the standard would only serve for the first renting. What about the second? Land values change. It is the aim of the single tax to gather in the values that grow with the progress of society. A large part of Mr. George's argument is addressed to the coming time when all available land shall be appropriated. Renting by auction is the only process that will enable society to collect economic rent surely, equitably, progressively, and scientifically.

I have no apprehension that the single-tax theory will ever get beyond the argumentative stage in this country, or in any country where small ownership is the characteristic feature of agri-

culture. The land-owners have so many stakes in the country, and these are driven so firmly, and woven together so tightly, that no revolution can gain head which has for its aim to dispossess them of their homes and acres, or to unduly tax them.

No evidence exists showing or tending to show that agricultural land in the United States is capable of yielding any considerable amount of public revenue above what it now yields under the tax laws of the several States. Evidence corroborating that cited from the Connecticut Bureau of Labor Statistics has been supplied lately in a rapidly swelling stream, especially in the official publications of the Commissioners of Vermont and New Hampshire, where there are literally tens of thousands of acres of abandoned lands, which were once the homes of thrifty farmers, and which can now be had for no greater price than the present value of the improvements thereon. A remarkable letter from Judge Nott, of the United States Court of Claims, in the "Nation" of November 21, 1889, presents facts and reasoning thereon, which, whatever else may be said, show conclusively that in the fairest parts of agricultural New England there is nothing left for the single tax to sweep into the public treasury. In the presence of such facts, how idle is it for disputants to cull figures out of the census reports, as Mr. Shearman does in the "Forum" article previously cited, to show what was the value of farms in 1880, and what annual percentage they ought to yield—like measuring a man for clothes, at the distance of a mile, with a theodolite!

There is no subject more bedeviled with dogmatism than taxation. There is none in which dogmatism is less helpful. The more study one bestows upon it the less will he be inclined to lay down inflexible rules. While justice should be ever in the mind's eye, yet our conclusions must always be mainly experimental. Of all the dogmas on taxation the single tax on land is the most dogmatic, and the one least favored by experiment, so far as experiment has been made. In India the single tax has been in force from the earliest times, supplemented by other taxes only after economic rent had been exhausted. During the last half-century British India has been well governed, so that whatever blessings the single tax has in hiding ought there to have been disclosed. That it has not abolished poverty, or exhibited any tendency to do so, may be confidently affirmed.

There are some hundreds of professors of political economy in the colleges and universities of the civilized world. They are of various schools, including that of state socialism. Some are conservatives, others progressives, still others may be called radicals. They are men who have somehow got themselves recognized as fit to instruct others in the principles of the science which deals with the production and distribution of wealth, with land, labor,

capital, interest, taxes, etc. Of course, they have all had their attention called to the single-tax doctrine. It has been "in the air" for ten years, and it is their business to know all the discoveries in their science, just as it is that of astronomers to know all the finds of new comets and satellites. If any one of them, either in Europe or America, has given his adhesion to the doctrine, I have not heard of him. All who have taken the trouble to give any opinion about it have spoken adversely. It can not be said that they are afraid to speak their real sentiments; most of them are free-traders, and nothing has been more unpopular than free trade, although that tide appears now to be turning. If the single tax contains the germ of truth, is it not a little remarkable that no member of the profession should have perceived and acknowledged it?

CHINESE SILK-LORE.*

By General TCHENG-KI-TONG,
SECRETARY OF THE CHINESE EMBASSY AT PARIS.

THE time of the hatching of silk-worms in China always corresponds with the first thunder of spring. As soon as the detonations are heard, a watch is set upon the eggs, which have been carefully made ready beforehand for the occasion; and the appearance of the larvæ may usually be counted on within five days, more or less.† Thunder at this season is the sign of that condition of electrical movement in the air which is produced artificially in Europe to hasten the hatching, by means of a shower of sparks.

For the protection of the mulberry-trees, the raising of *polyvoltines*, or worms that hatch several broods a year, is forbidden

* From an address given at the Orange Garden of the Tuileries, during the exhibition of Useful and Injurious Insects.

† The Emperor Yu, called the Great, ascended the throne 2205 B. C., and reigned twenty-seven years. He founded the second dynasty and completed the civilizing work of the Emperor Hoang-Ti, of whom he was a descendant. He divided each of the signs of the zodiac into two equal fractions of 15°. The farmers observe with the greatest attention the manner in which the several parts of this cycle follow one another, and prognosticate concerning meteorological phenomena from them. The observations made at Zi-ka-wei by Father Dechevrens do not lead us to suppose seriously that there was any foundation for this superstitious meteorology. The date of the entrance of the sun into each of these twenty-four divisions was indicated by that of the Chinese New Year. According to the calendar for 1888, as marked out by Bishop Perney's table, the 14th of February was the date for the opening of spring; February 29th, for rain; March 15th, for the hatching of silk-worms; March 31st, for real spring, etc. There is nothing absurd in the idea of a connection between the first electrical phenomena and the hatching of the worms; for the early electrical phenomena are usually associated with an atmospheric temperature favorable to such changes.

in many countries. But most caterpillars have only three moltings. Here I may remark that we define two periods in the moltings: the first, when the worms cease to take food, when we say that they lie down; and the second, when they lay aside their envelope, which we call their getting up. We also say, when we smother them with hot water, that they are taking a bath.

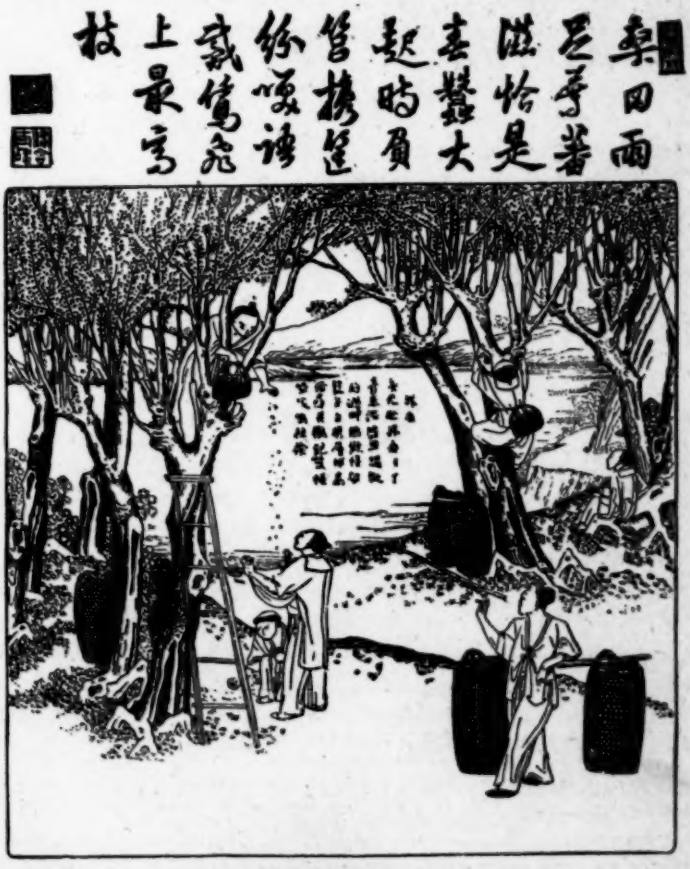


Fig. 1.—Collecting the Leaves.

Climbing the trees, the village boys
Fill the air with the songs of their age;
Each of the trees has its owner,
But every one respects his neighbor's.
The living leaf flies to-day into our basket,
And the zephyr is less quick than the hand that gathers it.

I am not acquainted with the significance of these terms, to lie down, get up, and take a bath; but I suppose that those who are charged with the duty of raising the worms wish to give them an orderly regimen.* The quality of our silk and the

* The verse subjoined to our second illustration expresses the same thought as the remark of General Tcheng-Ki-Tong, that, to preserve the luster of the silk, the worms that

FIG. 2.—SEPARATION OF THE WORMS ABOUT TO SPIN.

A peculiar luster of the worm's belly
Is a sign that it is about to change,
And that its mouth will spin us its silk.
Madam busies herself in preparing its bed,
And lays it on the straw, that nothing may soil
The immaculate thread which itself fixes.

method of manufacturing are so well known that it is not necessary to relate them in detail in this short address; but I must remark upon one feature which, I believe, exists nowhere but

have ceased to perform their digestive functions must be carefully separated from those which continue eating. This duty, which requires experience, devolves upon the matrons, while the fabrication of the thread is assigned to the young women. But the separation is hardly as absolute as is assumed by the poet. It may be seen from our figures that the Chinese women, in preparing the silk fiber, use extremely rudimentary processes; but it must be remembered that manual labor is very cheap among the Celestials, and that, consequently, they have few inducements for economizing. The people, men and women, are assiduous workers, and make available instruments so rude that Westerners would find it very hard to use them at all. Only the culture of the domestic silk-worm is described in the treatise of the Emperor Kang-Hi, while the less precious though useful fiber of the wild worm is prepared in a quite different manner.

with us, and the discovery of which goes back to ancient times. I mean the music of silk. My countrymen, even before they had invented the art of working silk and making cloths of it, had discovered the secret of making it musical, and of drawing from it the sweetest and most tender sounds. From the time of the Emperor Fo-Hi (3000 B. C.) they made an instrument consisting of

FIG. 8.—FABRICATION OF THE THREAD.

The steps in front lead to the clear water
In which, carried by a maiden, the skein
Is rinsed; on the right a turning wheel
Winds it, for ready hands to change it oft,
With care that it do not get knotted and tangled.

a board of soft, light, and dry wood, on which they stretched cords of silk twisted between the fingers. The board gradually assumed a definite shape and curvature, with measured dimensions. The cords were more artfully spun and composed of a determined number of fibers, and the number of them was fixed according to the character of the instrument desired. These cords, properly adjusted as to size and tension, were made to give

the tones of a regular stringed instrument. Such was, in short, the origin of our first musical instruments, the *kin* and the *ché*, which were both invented by the same person and at the same time, and both give the peculiar sound of silk.*

The construction of the instrument kin affords matter for an interesting study. It is made of toung-wood. The upper part is rounded, to represent the sky; the lower part is flat, and represents the earth. The abode of the dragon—that is, the upper part, from the bridge, eight inches down—represents the eight areas of the wind; and the nest of Foung-Hoang, or the same part at four inches in its height, represents the four seasons of the year. It is furnished with five cords, representing the five planets and the five elements. Its total length is seven feet and two inches, representing the universality of things. The inventor, by means of this instrument, first regulated his own heart and restrained his passions within just limits. He then labored to civilize men. He made them capable of obeying the laws; of doing acts worthy of reward; and of engaging in peaceful industry, by which they acquired the arts. Besides these five cords which give the five full tones, there are two others that give the half-tones and represent the sun and moon.

Concerning the construction of the ché, I will only mention that it had fifty and still has twenty-five cords; for I perceive that I am saying too much about the music of silk. It was, however, proper to give a full account of the kin, for it represents the first application of this music.†

* The engravings accompanying this article are from photographs from an edition of the poem of the Emperor Kang-Hi, published at Shanghai. They show most evidently that the artist has depicted customs of a very remote antiquity. Men are employed only for operations that require strength, like the cultivation of the mulberry-tree, the collection of leaves, etc. The legends beneath the designs are free translations of the Chinese verses above them.

† The inventor of the kin and the ché was no other than the Emperor Fo-Hi, who reigned about two hundred years before Hoang-Ti. The invention of thread and of fire is attributed to him; and he taught men, who had previously eaten their meat raw, to cook it. The ché kept its fifty cords till the time of Hoang-Ti, when a young maiden played it before the emperor with such effect that he concluded that it was a dangerous instrument to hear, and too liable to excite the passions of the people. Instead of throwing himself at the feet of the siren, as a European monarch would have done, he in his wisdom decreed that the ché should in future have only twenty-five cords. Notwithstanding Hoang-Ti's edict, the number of cords has been varied several times. There have been sometimes twenty-seven, sometimes twenty-three, and sometimes only nineteen, but no one has ventured to go back to fifty; the changes having been instigated by considerations of the significance of numbers, to which the Chinese are much addicted. The ché has now twenty-five strings. Each string is held by a colored bridge. The first five are always blue; the next five red; the next yellow; the next white; and the last series black. The bridges are movable, and each one is adjusted according to considerations that we shall not enter into. There are four kinds of ché's, which are of different length, but of identical construction. They are played at court and in the Confucian temple. In the latter case four instruments

You know so well how our silk-worms are cultivated that I need not relate the details of the method. In principle there is not much difference between our method and yours; possibly yours is only a copy of ours, without pretending to possess any novel features. But our system goes back to twenty-seven hundred years before Christ. The queen of the Emperor Hoang-Ti at that time first conceived the idea of raising silk-worms and of making from their production garments with which to clothe the people over whom her august husband ruled.*

The invention had such a following that it is still spreading through the whole world on a growing scale. Notwithstanding we have the wool and fur of animals, silk still is and always will be an article of luxury that no one who has the means of getting it will do without.† We, who are always grateful to our benefactors, honor the inventor of the art of silk-culture with a real perpetual cult. Besides the temples which we have erected in all the corners of the empire, her Majesty the Empress goes every year at the hatching season, in person, with all her suite, and in great pomp, to the field of the mulberry, to sacrifice to the goddess who was the queen of the Emperor Hoang-Ti.‡ After the cere-

are used, two of which are placed in the east and two in the west. Music was regarded by the ancient Chinese as an affair of state and religion, as a science revealed from heaven, a ray of the universal harmony emanating from divinity. Celestial forces and virtue were attributed to it. It was to them the science of sciences, the one by which all others were explained, to which they were related and from which they were descended. The modern Chinese have not abandoned their notions, although the sound of their music does not suggest them to Europeans.

* This celebrated woman, whose name was Loui Tseu, is adored as the goddess of silk. She was born, according to the Chinese historians, 2697 B. C., in the city of Si-Ling. Her husband was the first Chinese legislator, and reigned a hundred years—from 2737 B. C. to 2637 B. C.—and died at the age of one hundred and twenty-one years. One of his ministers composed the famous Chinese cycle; another constructed the celestial sphere; and a third regulated the notes of the gamut, with which he associated a metrical system. The Chinese refer the invention of wagons, bows, spun goods, and bells—in short, the origin of civilization—to that period.

† Mencius, the Chinese philosopher next in esteem after Confucius, said that after fifty years of age one could not keep warm without wearing silk clothing. It is likely that even before the time of Hoang-Ti the Chinese could make cloth of the silk of the wild worms, those that lived on the oak, for example. Another use of silk, which the author does not mention, was in the fabrication of the cords by means of which grand dignitaries received orders to strangle themselves. The messengers, who communicated the sentences to them, besides bearing the order written with the terrible vermilion, were usually instructed to proceed with the execution in case the victim had not courage to perform it himself. On the other hand, the emperor often expressed his satisfaction through gifts of balls of silk; whence originated the expression to "present the silk"; and this, being confounded with the sentence-bearing cords, has given rise to some curious mistakes.

‡ The calculation of the days for the performance of the traditional sacrifices by the Emperor is one of the principal duties of the astronomers of the observatory at Pekin. Since the ancient formulas no longer suffice for the determination of the dates, the astronomical bureau includes several Europeans, who are called assistant astronomers, and are

mony at the temple, her Majesty, followed by her ladies, goes into the field, and, surrounded by the farmers' wives, cooks some mulberry-leaves and lays them on a basket containing the newly hatched worms. The festival is closed with her winding a cocoon

FIG. 4.—THANKS TO THE GODDESS OF SILK.

In Szechuen our ancestors in ancient times
Became masters of the precious worms;
So, when the snowy skeins we see,
Let us pay our vows, all, at Louï Tseu's feet,
Bending our heads before her shrine,
Offering her silk and the flowers of the land.

by way of setting an example, in the presence of the people, and distributing gifts to those persons who have been reported by the authorities of their villages as most worthy by reason of their fidelity in attention to the care of the silk-worms.

charged with making all the calculations. There are four full astronomers, two Chinese and two Tartars, who appear in the religious solemnities. Under the reign of the Emperor Kang-Hi the astronomers were Jesuits, and had a great influence at court. But they were denounced at Rome by the Franciscans, as favoring idolatry. A suit ensued, which the Franciscans gained, and the Jesuits had to resign their long-held functions.

This ceremony, which is one of the most important of those her Majesty has to perform during the year, is a great incentive to the silk-raising population, who can not neglect their own work when they see their sovereign occupied in the same way. An old proverb says that "an idle farmer causes two persons to die of hunger, and a woman who will not weave will see ten dying of cold." The proverb illustrates the value of encouragement, and shows that silk-worm raising and weaving are duties of the women.—*Translated for the Popular Science Monthly from La Nature.*

LETTERS ON THE LAND QUESTION.

[*Continued.*]

By Prof. HUXLEY, HERBERT SPENCER, AUBERON HERBERT, FREDERICK GREENWOOD, and DARCY WILSON.

PROF. HUXLEY'S SECOND LETTER.

To the Editor of "The Times":

SIR: After a careful perusal of Mr. Spencer's letter in "The Times" of to-day, I fear I can only reiterate my declaration that he "has not helped us much." So far as anything said in that letter goes, it remains an open question whether Mr. Spencer agrees, in principle, with Mr. Morley's "hecklers" or whether he does not. If any one maintains that private ownership in land was originally set up by force or by fraud, and consequently has no ethical foundation, I think, as matters stand, he has a right to cite Mr. Spencer's authority in favor of that position; and I, for one, very much regret that any person should possess that right. It seems to me lamentable that the "absolute political ethics" of to-day should have got so very little further than the point reached by Rousseau, the absolute political philosopher of one hundred and thirty years ago, who tells us that—

Le premier qui ayant enclos un terrain s'avisa de dire *Ceci est à moi*, et trouva des gens assez simples pour le croire, fut le vrai fondateur de la société civile.*

Rousseau laments that there was no one to pull out the stakes and fill up the ditch of this primitive land-grabber; and to warn mankind that "the fruits of the earth are everybody's and the land nobody's."

These passages are cited from the famous "Discours sur l'Origine de l'Inégalité parmi les Hommes," published in 1754, in which I think will be found, implicitly or explicitly, all the propositions

* [The first one who, having inclosed a field, took it into his head to say "This is mine," and found people simple enough to believe it, was the true founder of civil society.]

which Mr. Laidler discovers in "Social Statics" and attributes to Mr. Spencer.

However, these are matters of opinion; and as Mr. Spencer, leaving the main issue aside, has put me on my defense, I hope I may say a word or two to show how very easy that process is; for, surely, nothing can be easier than to refuse to be charged with the consequences of opinions one does not hold. Mr. Spencer says that I "admit that all land-holders hold their land subject to the supreme ownership of the State"; and his remarkable inability to see that we disagree on the land question flows out of this assumption. But I admit nothing of the kind. If I declare that, under certain circumstances, the State has a right to shut me up and to make me work on the tread-mill, or to hang me, or to dispose of me and my property in any other way, it does not appear to me that "by implication" I admit that I hold my property, my liberty, and my life, "subject to the supreme ownership of the State." Surely the State is not my owner—I am not a serf—because I admit the right of the State to do these things! It is absolutely unintelligible to me that on such grounds as those alleged any one should try to force me to the conclusion that "the community, as supreme owner, with a still valid title, may resume possession if it thinks well."

And this leads me to another point. What historical ground is there for the assumption that the community (in the sense of "the State") ever had a "valid title" as universal land-owner? I am not ignorant that there have been and are such things as "village communities"; and if any one chooses to assert that communal ownership is the primitive form of land-holding, I am willing, for the sake of argument, to admit that such is the case. Let the further assumption that no agencies save force and fraud have broken up the communal organization (astonishing as it is) be accepted. Well, then, I see that a sort of an argument (though I think a very fallacious one) in favor of going back to ownership by village communities might be founded on these *data*. But what has that to do with State land-ownership, which has not the remotest resemblance to the communal system of antiquity?

Mr. Spencer addresses a sort of *argumentum ad hominem* to me. It is hardly chosen with so much prudence as might have been expected. Mr. Spencer assumes that, in the present state of physiological and medical science, the practitioner would be well advised who should treat his patients by deduction from physiological principles ("absolute physiological therapeutics" let us say) rather than by careful induction from the observed phenomena of disease and of the effects of medicines.

Well, all I can reply is, Heaven forbid that I should ever fall into that practitioner's hands; and if I thought any writings of

mine could afford the smallest pretext for the amount of manslaughter of which that man would be guilty, I should be grieved indeed. Mr. Spencer could not have chosen a better illustration of the gulf fixed between his way of thinking and mine. Whenever physiology (including pathology), pharmacy, and hygiene are perfect sciences, I have no doubt that the practice of medicine will be deducible from the first principles of these sciences. That happy day has not arrived yet, and I fancy it is not likely to arrive for some time. But, until it comes, no practitioner who is sensible of the profound responsibility which attaches to his office, or, I may say, is sane, will dream of treating cholera or small-pox by deduction—from such mere physiological principles as are at present well established. And if this is so, what is to be said of the publicist, who, undertaking to preserve the health and heal the diseases of an organism vastly more complicated than the human body, seeks guidance, not from the safe, however limited, inductions based on careful observation and experience, but puts his faith in long chains of deduction from abstract ethical assumptions, hardly any link of which can be tested experimentally?

No doubt a great many foolish laws are passed. Also a great many foolish prescriptions are written; but the latter fact is not evidence in favor of "absolute physiological medicine," any more than the former testifies to the value of "absolute political ethics."

I am, sir, your obedient servant, T. H. HUXLEY.

EASTBOURNE, *November 15th.*

MR. HERBERT'S LETTER.

To the Editor of "The Times":

SIR: I more than suspect that my friend Mr. Greenwood can not have escaped a few 'moments' quiet amusement the other morning when he read his own letter in "The Times." Mr. Spencer, after many years, slowly and cautiously modifies a view formed earlier in life, and Mr. Greenwood thereupon addresses to the whole body of philosophers, to make use of his own words, "a heavy lesson." When, *currente calamo*, he took the philosophers under his charge for the purposes of instruction, did it never occur to him to ask himself how many oracles of his own it is the fate of the most careful editor—be he who he may—in the course of even one short year of political warfare to recall and silently replace by their opposites? The philosophers may have their faults, but I am afraid they are hardly to be convicted of them by any one who has, closely or remotely, independently or subserviently, followed the zigzags of political life.

And now as regards the question itself. There are some of us who have been watching for years with great pleasure the growing change in Mr. Spencer's views about land, and have only wished

the change might go further. We have looked on "Social Statics" as one of the most splendid and helpful books ever written in the English language, and even the blot, as it seems to us, of land nationalization could not dim our enthusiasm for it; and now we —in saying "we," it is not an undivided "we," for I admit fully the divisions among individualists on this point—rejoice greatly to think that our leader has, at last, his doubts and hesitations whether land nationalization is a true article in the creed which he has taught us.

May I now add some reasons to those already given in "The Times" why land nationalization is both bad as philosophy and bad as expediency?

1. As philosophy. It is said that the land of a country belongs to the people as a whole. But if so, it is clearly the people, that is, the whole people without exception, to whom it belongs, and not a majority among them. Philosophy must be exact in her terms, and if she says it belongs to the people, she can not possibly mean two thirds or three fourths, or some other unstated quantity short of the whole. It may be, I can readily understand, a matter of practical convenience to politicians and other believers in power to treat a majority as society; but no amount of torture could wring from a Philosophy that knew what she was talking about the admission that the two things are equivalents. The deductions from this are plain. Property belonging to the whole people could never be used by any part of them, for the consent of the whole could not practically be got as regards any special use of it, seeing that every day, almost every hour, that whole is changing. We can, therefore, hardly accept a theory which lands us forthwith in an absurdity.

2. If the soil belongs to society in the abstract, and if, notwithstanding the urgent remonstrances of Philosophy, we decide to interpret the word "society" by the word "majority," why is it taken for granted that it belongs to that majority of the people who at any given moment happen to inhabit it? If the Chinese are overcrowded, or to come nearer home, if the Belgians are overcrowded, or if some part of the Russian people possesses a less attractive portion of the world to live in than our own, can they not claim with unanswerable logic that the doctrine of the majority has no merely local application, but must be treated in a far more comprehensive spirit? If Philosophy says the land of right belongs to the majority, it must also answer, "What majority?" and the nations that are now located on the least advantageous spots will not answer that question in quite the same way as the nations that enjoy the sunny side of the hedge.

3. It is claimed that the present owners may be dispossessed by force because some of them (a quantity that is diminishing

every day—see the yearly returns of land-sales) became possessed in old days of their land by force. But if an act of ancient force is sufficient cause to disinherit these holders of land, it must, I fear, also disinherit the whole nation, for we all came here by force. Celt, as far as we know, Anglo-Saxon, and Norman came by force, and the nation that is rather strangely asked to show its horror of past force by carrying out anew another wholesale act of force, is itself out of court for the very same offense as that under which it is proposed to condemn the land-owners.

4. All the articles of use and commerce—if we except those taken from water—are drawn in the marvelous laboratory of nature from or under the soil, or from the soil and air combined. Every tree, every crop of corn or roots, every fleece, contains in itself positively and actually so much of the soil where it was raised. Where, then, is the logic of declaring that certain particles—and these the very best—when taken from the soil may be private property, while the other particles—which are generally of lesser value—left lying in the field are, by some abstract right, the property of an unknown and unstated portion of the people—called a majority—who have never yet set eyes upon their property, and could not distinguish it if they did? My coat is now my private property; but years ago, before the grass grew which fed the sheep, the larger part was public property. What a marvelous transformation, and what inextricable confusion both of theory and of fact! How a thing which, as a matter of abstract right, once belonged to everybody, can rightly become my private property, I am utterly unable to understand. Perhaps Mr. George or Mr. Laidler could help me.

Then for the expediency. Is the race to deprive itself, for the sake of a theory that can not hold what is put into it better than a sieve can hold water, of the immense happiness and comfort that may come to thousands and thousands of families from the permanency of possession? If the land belongs to the majority, can there be this permanency? How can you let A and A's family retain forever the possession of the holding which he has industriously acquired, when B and C are waiting for their turn of what, without any industry or acquisitive virtue on their part, is declared to belong to them? That A is better fitted—naturally selected—to fill the holding, to use it happily and profitably for himself and for society, must count as nothing in face of the fact that B and C have taken the trouble to be born the owners of it. Then, too, comes in all the trouble and confusion about improvements, where property is split into this double ownership between the abstract state and the concrete holder. Improvements, we are told, can only realize their full value if there be a free sale and fixed rents. Do any persons in their sober senses imagine that

the hungry, greedy, necessitous state of the politician will ever place itself on the same footing as it has placed the Irish landlord, upon whom the other day it so freely practiced its cheap philanthropy; that it will ever consent to fix its rents in perpetuity, or to abide by them if they were fixed? Then comes all the unutterable official management, the inspectorate, the armies of surveyors and clerks, the arrogant petty kinglets, the red tape, the annoying conditions, the unending correspondence on the subject of the new pump or the new road, the constant battle in Parliament as to new methods of land-tenure, new methods to allow A to replace B in quicker succession, new forms of land-taxation, universal upsetting of existing system, and universal establishment of the last land fancy of the half-baked theorist. Conceive for one moment the slough of despond into which you would plunge back a vigorous, self-helping nation that had once, however hesitatingly and half-heartedly, taken the first few steps along the road of individual initiative, experiment, and progress.

No, it is in another direction our efforts must be turned. Years and years ago, if our political parties were not—both of them—like wild beasts fighting, with no thought or sense, but for the mad struggle in which they lie locked together, biting and tearing with tooth and claw, they would have freed the land. They would have broken the lawyer's yoke that still curses our present generation and again and again prevents the ready sale, and they would have got rid of the heavy burdens of rate and tax that now fall on land and make it an undesirable possession for the poor man. Of all pieces of stupidity none is greater than taxing land just because the rich man at present holds the larger part of it. It is like all other pieces of class legislation, branded on its forehead with the fool's mark. You strike at your supposed enemy and wound yourself. Land must be made free in the only true sense—free from the clutch of the lawyer, free from the visits of the tax and rate collector, and it will then become the greatest source of happiness and comfort to our people. Once really freed, the industrious, vigorous poor will slowly wrest it from the rich man, paying, as has been seen in France, notwithstanding the heavy State burdens on land, a price that the rich man will not pay for its acquisition. Above all other forms of investment for the poor man, land is far away king. It is no pig in a poke for him. He knows it, he understands it in all its good and bad qualities better probably than any other living man; he can not be juggled out of it, when it is once bought, by the carelessness or fraud of directors; he can put all his spare time and spare labor into it. It is not, however, a question of the agricultural laborer alone, but also of the saving mechanic in town, who would look forward to the bee farm, or flower or fruit farm, on which he might end his days.

It is not only a question of the townsman; it is also a question of co-operative and trade-union societies, who also would learn to put their investments in land, perhaps producing for themselves, and offering in many cases opportunities of country life to their members who needed rest and change. Unless we persist in follies upon follies in the shape of legislative interferences; of expensive machinery to provide the people with land—machinery that will defeat its own object, for it must be paid for out of the rates, and will therefore increase the burdens on land; of forced agricultural agreements between landlord and tenant that tend to stereotype all farms in their present size; of State-hired allotments that, as in the case of our benighted dealings with Ireland, must tend to weaken the desire for ownership, the land of this country, now thrown upon the market at prices so far below its real value, industriously acquired and held in firm, unalterable fee-simple, will prove the greatest blessing to all classes of our working people. All that is wanted is to keep land free—free alike from Radical messing and Tory messing, and leave it what it naturally is—until spoiled by that blessed politician whose eternal finger finds its way into every pie—the sweetest reward for a man's labor and the most powerful incentive to undergo those labors. If you wish to develop all the virile virtues of our English country folk, and to place before them a worthy goal for their life-efforts, sweep away every obstruction and make it easy for them to gain their own home, held neither at the will of the land-owner nor of that worse modern creation—the changing majority inside Parliament.

I notice that Mr. Spencer still allows himself to think of that ogre, the land-owner, who might clear a district if so minded. That is true; but may I submit to him that it is equally true of a majority, and in one sense more true? A parliamentary majority which once considered itself lord and master of the soil might play any prank under high heaven that once occurred to it. It would be quite likely to turn a perpetuity into a thirty years' tenure, or a thirty years' tenure into a fifteen years' tenure, or to revolutionize every home in England in deference to the last notion that had got uppermost in its infallible head. Moreover, it should be seen that once the spirit of individualism begins to get hold of our people, the action of the landlord who cleared the estate would serve to redouble the efforts of the people to become absolute owners of their property. Unconsciously he would be the instrument of a good greater than the harm he had caused. We have not yet sufficiently profited by Mr. Spencer's teaching to recognize the enormous stimulus for good which there is in every form of evil when once we are fairly on the track of fighting it with the true self-helpful remedies. What delays and impedes the human race is far less the evil that abounds than the false

remedies which we apply to cure it. It is hardly too much to say that human improvement is due to the evils and difficulties of life overcome in the right way.

One last word. Men doubt about "absolute political ethics." Yet they do not doubt about absolute principles in physics, in chemistry, in biology, in psychology, or even in the ethics of private life. Does it never strike them that it is a mightily strange thing—requiring, I think, some explanation on their part to which they do not often condescend—that we should live in this world almost surrounded by order, or fixed law, on every side of us, and yet in one special department of it—that of political action—this order should suddenly be replaced by disorder and uncertainty? Does it never occur to them that this strange inexplicable contradiction may be not in nature, but possibly only in their own minds? Does it never occur to Prof. Huxley, who is not an admirer, I suspect, of our party warfares, that the danger of modern civilization, the unscrupulousness, the corruption, the cowardice, the shiftiness, the untrue motives that flourish in public life have their stronghold in this belief that politics are an Alsatia, where alone in the wide universe the writ of the Great Power does not run? Does he not see that as long as politics are held to be outside moral law and scientific statement so long we shall be at the mercy of all those who for their own purpose try to persuade the people to believe the ignoble creed that whatever they desire is right, that the measure of their wants is the measure of the just and true? Some day, when possibly men may have forgotten "the heavy lesson" my friend Mr. Greenwood addresses to the philosophers, they may, warned by the great social dangers pressing upon them, turn round and see the full meaning of Mr. Spencer's work, and understand that he alone has pointed to them the path that leads out of the wilderness.

May I say that I am always glad to send some of our individualist tracts to any person who writes to me?

I am, very faithfully, AUBERON HERBERT.

OLD-HOUSE, RINGWOOD, *November 14th.*

MR. GREENWOOD'S SECOND LETTER.

To the Editor of "The Times":

SIR: If the question is whether Mr. Herbert Spencer is right in endeavoring to purify the conduct of public affairs and discharge it of error by establishing a system of "absolute political ethics, or that which ought to be," I submit that he need not have said so much as he has lately said in your columns. Who doubts that he is right? Who doubts that he is wisely and nobly employed when his business is to discover the bases of true political morality, and to exhort mankind never to lose sight of them, what-

ever may be the stress of expediency or compulsion in the world as we find it? But is that the question that was raised on the conversation between Mr. Laidler and Mr. Morley at Newcastle? Not at all. By that conversation we saw in a remarkably plain way that large numbers of the most intelligent and powerful representatives of labor in this country had derived from Mr. Spencer's teaching these conclusions: That private property in land is a public wrong based on force and fraud, and that to right one wrong it is sometimes necessary to do another. This they took to be a lesson in practical politics; and what it points to, in practice, is perfectly clear. Resume possession of the stolen land, if you please, for as private property it still is, and under its present ownership it must ever remain, a wrong to the community. For the rest, though compensation must be made for whatever is in the land which was not in it when it was stolen, yet to right one wrong it is sometimes necessary to do another. That is the point for attention as the matter stands at present. For though Mr. Spencer tells the people, as he could and should have told them from the first, that just compensation would entail a disastrous outlay, infallibly to become more disastrous through inferior management of the land by public officials, what of that if, to right one wrong, it is sometimes necessary to do another? What of just compensation, if it makes a standing crime against the community completely irremediable, and if the people are at liberty to decide whether this is not a case where to right one wrong it is necessary to do another? The point has been actually considered by labor societies and the leaders of the new Socialist movement all over the country, and it seems quite clear that the Newcastle Labor Electoral Association, for one, has come to the conclusion that, morally, there need not be much punctilio about compensation.

But perhaps Mr. Spencer has never said that to right one wrong it is sometimes necessary to do another. In one of his letters to "The Times" he wrote that he could not be positive whether he had or not; which seems to imply that he would not be surprised to learn that at one time or another he had included this doctrine in his teaching of absolute political ethics. Be that as it may, however, he could have told us when he was challenged on the subject whether this is his teaching now or not. He has written three letters; we remain in the dark on the most important point of all, and at the close of an argument entirely occupied with a defense of propagating "absolute political ethics" Mr. Spencer announces his determination to go no further with the controversy. Meanwhile here is Mr. Laidler in his old position, and here left. To be sure, it seems difficult to include the dogma he rests upon in any system of absolute political ethics; and if Mr.

Spencer had not said that he could not be sure that he had never preached it, we might conclude without further inquiry that the doctrine had never been his. As matters stand it would be an extremely good thing if he could assert that he does not hold it now, anyway. That done, his counsel against the nationalization of the land as a fatally bad bargain (since it must be carried out on just compensation principles if at all) would have full effect. It is to be hoped that Mr. Laidler's questions in "The Times" of to-day will be answered, and they will be if Mr. Spencer does not turn his back on doubting disciples who cry to him.

Your obedient servant, FREDERICK GREENWOOD.

November 15th.

MR. WILSON'S LETTER.

To the Editor of "The Times":

SIR: Mr. Laidler has given us a digest of the ninth chapter of Mr. Herbert Spencer's "Social Statics," and asks triumphantly, "Does it not constitute an unanswerable argument in favor of the nationalization of the land?" Mr. Spencer has modified the views expressed in that work, but, as Mr. Laidler now elects to stand or fall by them, it may perhaps be worth while to inquire how far they support his proposals.

The nationalization of the land, as defined by Mr. Laidler in his interview with Mr. Morley, means that the land, but not the houses, of this country should, on the death of the present owners, revert to the nation or State without any payment therefor.

In the "Social Statics" it is argued that each one of the race of beings born into the world has equal rights to the use of this world, and that no one or part of such race of beings may use the earth in such a way as to prevent the rest from similarly using it. From this it follows that land can not justly become the property of individuals; but it also follows that no given portion of the globe can justly become the property of any individual nation, for that would be to deprive the rest of "mankind at large," the rest of "the human race," of their equal rights. It is true that Mr. Spencer in one place says that under his system, instead of leasing his acres from an isolated proprietor, the farmer would lease them from the "nation." But this can only be reconciled with the rest of the chapter if the nation is understood to be acting as the "agent or deputy agent" of the community at large. According, then, to the argument in the "Social Statics," the land of this country should belong, not to individuals nor to the State, but to the human race.

Mr. Spencer is also in favor of giving existing owners compensation. On this he says that—

> Great difficulties must attend the resumption by mankind at large of their rights to the soil. Had we to deal with the parties who originally robbed the

human race, we might make short work of the matter. But, unfortunately, most of our present land-owners are men who have, either by their own acts or by the acts of their ancestors, given for their estates equivalents of honestly earned wealth, believing that they were investing their savings in a legitimate manner. To justly estimate and liquidate the claims of such is one of the most intricate problems society will one day have to solve.

What Mr. Spencer advocates is, in short, that the land should revert (*a*) to the human race, (*b*) after payment of compensation. And it seems to be generally admitted that the compensation would amount in the shape of interest on purchase-money to a greater sum than is now paid in rent.

So far, Mr. Laidler and Mr. Spencer do not seem to have much in common. The one point on which they do agree is that the existing titles to land are not legitimate, because they are founded on "force or fraud." Let us apply this view to England. When this country was conquered by the Normans the land fell into the hands of the sovereign, or, in other words, the State. It was then granted out in part to Normans, and in part to existing owners. How can it be said that the grantees obtained their land by force or fraud? They obtained it by grant from the State. The title of the State which made the grants did, no doubt, depend on conquest or force. But if this fact is to invalidate the title of existing owners, it must, *a fortiori*, utterly destroy the title of the State to resume its possession to-day.

The schemes, then, for dealing with the land appear to be three in number: (1) Mr. Laidler's, that the land should revert to the State without compensation; (2) that it should so revert with compensation; (3) Mr. Spencer's, that it should revert to the human race with compensation. Of these, the first has been truly described as robbery, and the second as folly. The third seems to be a philosopher's dream.

I have the honor to be your obedient servant,

DARCY WILSON.

BOODLE'S, ST. JAMES'S STREET, *November 16th.*

MR. SPENCER'S THIRD LETTER.

To the Editor of "The Times":

SIR: I suppose I may make a denial without continuing a controversy; and, unless I make it, a grave charge against me will remain unrebutted.

Over and over again Mr. Greenwood refers to the statement that I have said that "to right one wrong it is sometimes necessary to do another," and apparently wishes to force it upon me notwithstanding what I supposed was a sufficient repudiation. Being unable to recall all the contents of some ten thousand pages, written during forty years, I said as much as it seemed pos-

sible to say with reason; for it has sometimes happened that opinions have been quoted with approval as mine which I had quite forgotten were mine. I therefore wrote, "My belief is that I have not said this in any connection." That is, I am absolutely unconscious of ever having written it, and do not believe I ever did write it. I do not see what more was required. Mr. Greenwood urges that I have not repudiated it even now. It never occurred to me that, after what I said, this was needful. But, as he thinks otherwise, I very willingly repudiate it, both for the past and the present.

Even did I wish to continue my discussion with Prof. Huxley, it would be ended by his letter. From it I learn that the principles of physiology—as at present known—are of no use whatever for guidance in practice; and my argument, therefore, collapses.

I am, etc., HERBERT SPENCER.

ATHENÆUM CLUB, *November 18th.*

PROF. HUXLEY'S THIRD LETTER.

To the Editor of "The Times":

SIR: It seems to me to be a pity that the discussion which has been carried on in your columns should come to an end before Mr. Laidler's able letter of the 15th instant has been considered on its merits. I conceive it to be a matter of vital importance to the whole nation that the representatives of labor should be under no misapprehension with respect to the grounds of any action they may think fit to take. And as, all my life, I have done my best to bring sound knowledge within reach of the working classes, I trust that they will do me the justice to believe that I am actuated by no other motive now.

Let me say, at the outset, that I have expressed no opinion, and that I do not intend to express any opinion, as to whether State ownership of land is desirable or not. If it can be proved by arguments, having some foundation in practical experience, that the abolition of several ownership in land and the substitution for it of State ownership is essential to the welfare of the people, no one would feel more bound to give practical effect to that demonstration than I.

In Mr. Laidler's letter, however, such arguments are not employed. On the contrary, he adopts the method of Rousseau and his followers, which consists in making certain assumptions about matters of ethics in the first place, and certain assumptions about matters of history in the second place, and then drawing the obvious conclusion that the assumed facts are in sad disaccordance with the assumed ethical rules. It is a delightfully easy method, and saves all the trouble of going deeply and thoroughly

into the foundations of ethics and the truth of history which the scientific plodders give themselves.

Now, I do not propose to discuss the ethical assumptions set forth by Mr. Laidler. Let it be granted, for the moment, that "equity does not permit property in land," and that "men are equally entitled to the use of the earth." Well, starting from those axioms, I fail to see by what logical process one gets at State ownership. If "equity does not permit property in land," how does it contrive to permit State ownership? The State is only a name for a body of men; and, if "all men are equally entitled to the use of the earth," why have Englishmen any more right of property in the soil of England than Frenchmen or Germans, or, for the matter of that, the natives of Timbuctoo, have?

Thus it is the logical consequence of the doctrine of the Rousseauites that nations are as much usurpers as individuals, and that there can be no valid title to land until the whole surface of the habitable globe has been thrown into hotchpot, and that share which every man may enjoy the use of, without damage to his neighbors, determined by a cosmopolitan *plébiscite*.

Thus, if we are to appeal to logical consequences, those of the principles adopted by Mr. Laidler's authorities are just as startling as those of the principles of the advocates of the "absolute" rights of private property. And I would put it to Mr. Laidler, as a man conversant with the practical side of life, whether this does not suggest to his mind that modes of reasoning which lead to obvious absurdities must be fundamentally vicious?

Now let us turn to the historical assumptions of Mr. Laidler's authorities. They affirm that several ownership of land originated in force and fraud—whereby the nation, in whom the ownership was previously vested, was robbed of its rights. And from these *data* they argue that the nation is justified in "resuming" its "rights to the soil."

Now, this is an assertion as to a matter of historical fact which can be tested. In the course of the last thirty years a vast amount of evidence has been obtained respecting the manner in which land is and has been held by people in an early stage of civilization all over the world. And resting on this foundation of laboriously ascertained truth, is the conclusion that the tenure of land by communities is that which most extensively prevailed in remote antiquity. What this exactly means will perhaps be best made plain by the supposition that the land in every parish in England was owned, not by one or more private individuals, but by the males of one or more resident families, forming a corporation in which the ownership vested. The land of the community, in fact, resembled an entailed estate, which

should be inherited by all the males of a family collectively, they being forbidden to alienate any portion of it.

This "joint family" or "village community" system, therefore, so far from denying the right of several property in land, is founded upon that right. Assuredly, our ancestors did not trouble themselves much about the philosophical foundations of property. But I am well assured that if any one had tried to persuade a village community that all mankind had as much right as they to their land, that missionary of "absolute political ethics" would have been short-lived.

It may be said that I have been talking about the archaic existence of "several" property in land, while the question is about "personal" property. But is that so? Are the land reformers going to exempt corporate several ownerships in land, when they abolish personal ownerships? If so will they explain why corporate several ownership is less an infringement of the rights of mankind in general than personal ownership? But if corporate several ownership is not "permitted by equity" any more than personal property—if the archaic communities had no more valid title than the squires who have succeeded them—whence comes the evidence that those rights of "mankind at large" to the use of the soil, which we are told they are to "resume," ever existed?

Let us, then, clear our minds of all the cant of "history after the manner of Rousseau." Genuine history shows that, as far back as the constitution of settled society can be safely traced, several property in land was recognized and acted upon. It also affords much ground for the belief that individual property was recognized in the case of the clearer of forest land; that either individual or family several property was recognized in the case of the plot of land in which the house was situated; and that, in bringing about the change from collective to individual severalty, industrialism has been just as important a factor as militarism. State ownership may be right or wrong, but those who suppose it to be a resumption by the people of a right they ever exercised, or even claimed, are at variance with the plainest teachings of history.

I am, sir, your obedient servant, T. H. HUXLEY.

EASTBOURNE, *November 19th.*

P. S.—Mr. Spencer, in the letter which you publish to-day, says that he learns from me that "the principles of physiology, as at present known, are of no use whatever for guidance in practice." I think that Mr. Spencer must have achieved this feat of learning by his favorite *a priori* method, for nothing of the kind is discoverable by mere observation and deduction in what I have said. No phrase of mine is inconsistent with my belief that the principles of physiology, like those of ethics, are of great use, so

long as they are applied with that caution and discretion which are to be gained only by practical experience in medicine or in affairs. If Mr. Spencer were acquainted with the history of medicine or with the present relations of physiology and therapeutics, he would have been unable to learn from me that which it would have been ridiculous in any one to teach.

MR. GREENWOOD'S THIRD LETTER.

To the Editor of "The Times":

SIR: Without meaning to do so—I am quite sure of that—Mr. Auberon Herbert has placed me in a false light. It might be supposed, from a letter in which he deals with much more important things, that I had reproached Mr. Herbert Spencer with changing his opinions, which would be great presumption. That, however, I have not done; and, indeed, there is no reproach in changed opinions when they are not fundamental, and when the one judgment and the other are not based on the same unaltered *data*. My complaint was against the publication of imperfect theories of social reform "unaccompanied by a clear statement of whatever reasons are fatal to their application in this work-a-day world," the point being that certain doctrines of Mr. Spencer's, acknowledgedly ill-considered and so unaccompanied, had gravely misled large numbers of men eager for social revolution. That is a very different thing from complaining of reasonably changed opinion. Mr. Auberon Herbert seems also to make out that, on the ground of reasonably changed opinion alone, I presume to impose "a heavy lesson" on political philosophers. It would have been arrogant indeed if I had so described my interference, as Mr. Auberon Herbert suggests. But here he does me wrong altogether. My account of the matter was that the conversation between Mr. Morley and Mr. Laidler, together with Mr. Spencer's letter on that conversation, conveyed "a heavy lesson" to political philosophers. That is what did it. I had nothing to do with a lesson ready made.

The controversy has been extremely useful—thanks to your liberal publication of it—and will do a world of good all round, especially after Mr. Spencer's welcome letter of to-day.

Your obedient servant, F. GREENWOOD.

November 19th.

PROF. CROOKES expresses the opinion, pertinent to his researches on the rare earths, that while, besides compounds, we have hitherto recognized merely ultimate atoms or the aggregations of such atoms into simple molecules, it is becoming more and more probable that between the atom and the compound there is a gradation of molecules of different ranks, which may pass for elementary bodies. For these bodies he offers the provisional name of "meta-elements." Their true character should be the subject of future unbiased research.

EXERCISE FOR CHEST DEVELOPMENT.*

By FERNAND LAGRANGE, M. D.

HOW is it that the lungs can increase in size through athletic exercise? By a mechanism well known in physiology, by the filling out of certain air-cells ordinarily inactive, which only come into play during forced inspiration. The expansion of the pulmonary vesicles is complete in proportion to the quantity of air introduced. The atmospheric air drawn into the lungs by a very powerful inspiration seeks out the most obscure corners, and inflates the air-cells of certain regions which ordinarily have no part in the respiratory function.

A definite increase in the volume of the lungs is the consequence of frequent repetition of this supplemental respiration. The air-cells which are as a rule inactive, and which are reserved for cases of excessive respiratory strain, arise from their inaction; their walls, which are usually collapsed, and even stuck together, separate and give entrance to the air which can not find room in the confined space sufficient for ordinary breathing.

If the forced inspirations are often repeated, the air-cells, the action of which has thus been accidentally solicited, come in the end to associate regularly in the ordinary respiratory movements. They are then very quickly modified in the sense most favorable for efficient working, according to the law we have so often pointed out, of the adaptation of organs to the functions they perform.

Thus, forced respirations result in a modification of the structure of certain regions of the lung, and in making them work better. Under the influence of unusual exercise the vesicles increase in size and contain more air. More blood is also supplied to them. Their capillary network becomes richer, and their nutrition more active. Thus in the end they take up more room.

It is in this manner that the regular working of a great number of air-cells, ordinarily inactive, can rapidly increase the size of the lungs.

If we follow out the modifications produced by forced respirations, we see that the lungs thrust outward the thoracic walls to make more room for themselves. During inspiration the ribs, by rising, favor the inflation of the lungs; but in this case it is the lungs which, having increased in size, thrust the ribs upward and keep them raised even in the condition of repose. Hence an increase in the circumference, and a vaulted conformation of the thorax.

* From advance sheets of the author's work on "Physiology of Bodily Exercise," in the "International Scientific Series," to be issued shortly by D. Appleton & Co.

It is then *from within outward* that the force capable of expanding the chest acts, and it is in reality to the lungs and not to the muscles that the chief share in the changes in form and size of the chest belong. The most powerful inspiratory muscles can not raise the ribs, unless the lungs participate in the movement of expansion, and, on the other hand, the lungs can raise the ribs without the aid of the muscles, for the chests of emphysematous patients remain vaulted in spite of their efforts to lower the ribs and complete the expiratory movement.

If we sum up the facts we have just enunciated, we shall be driven to the conclusion that, in order to raise the ribs and get rid of the vicious conformation of flat chest, we must not seek to act directly on the thoracic muscles, but to produce as extensive respiratory movements as possible.

There are two methods of amplifying respiration: one consists in voluntarily expanding the thorax in all directions. This method is in the domain of "chamber gymnastics"; it has been much extolled, and it may give good results. The other method comes more directly into the field of our studies. It consists in increasing by exercise the amplitude of the respiratory movements.

The problem has now become clear and definite. We need, in order to develop the chest, to know what exercises are most fitted to produce a series of very extensive respiratory movements. Now, the amplitude of respiration, as well as its frequency, is in direct ratio to the intensity of the respiratory need, and we know that the intensity of this need depends on the quantity of mechanical work performed in a given time.

The exercises which cause an *accumulation* of work are, then, those most fitted for increasing the size of the thorax, and for demanding increased work from the lungs. And we know that this accumulation of work occurs especially in exercises of strength and speed.

Thus the mechanism of exercise, its performance by the aid of these muscles or of those, are of secondary importance in producing the result of which we are speaking. It matters little by what process the muscular force is expended, provided that there is great expenditure in a short period of time. It is indifferent whether the movements are very slow, each of them representing a great number of kilogrammetres, or whether they are extremely rapid, each movement representing but a moderate effort. It is merely necessary that the sum of work represented by these movements, whether few or many, should be considerable in a short time.

Now, the quantity of work which a given muscular group can perform in a given time is subordinated to the strength of this group. There are muscular groups which are too weak to ex-

pend much force in a short time. One arm may use its whole strength without its work representing, in the unit of time, a great number of kilogrammetres. So, whatever form the exercise takes, if the arm alone is working, we shall not find that the breathing is much quickened. The exercise may induce local fatigue before the intensity of the respiratory need has increased. It may even happen that the work of both arms together does not, after a given time, amount to enough to demand more ample respirations.

In general, the exercises which are performed with the legs represent more work than those which are performed with the arms. The muscles of the upper limbs could not support, without extreme fatigue, an expenditure of force which will cause no effort to the lower limbs. It is not tiring to any one to walk five hundred metres in five minutes: what gymnast could traverse the same distance in the same time hanging by his hands from a stretched rope? The total mechanical work would be, however, the same—displacing the same weight through the same horizontal distance.

We must not, then, trust to the muscles of the arms to expand the chest. Muscular exercise can only lead to the development of the thorax in an indirect manner, and in no way by a direct effect comparable to the increase in size of a muscle which works. The muscle which contracts often becomes larger because its nutrition is more active. But the chest only expands when the surcharge of the blood with carbonic acid creates a need of a greater quantity of oxygen for hæmatosis.

It is to the more active respiratory need, to the "thirst for air," that the instinctive movement by which the ribs are more energetically raised is due, in order to draw into the lungs a greater quantity of air.

The thirst for air, carried too far, produces breathlessness, which is nothing else than a powerless struggle of the system seeking in vain to satisfy a need. When breathlessness is very moderate, it causes very ample respiratory movements; but when it is excessive, the breathing becomes very shallow as well as very rapid. So that exercise has no longer any effect in expanding the chest when breathlessness reaches an extreme degree.

To sum up, the most profitable way of dilating the lungs, developing the thorax, and expanding the chest, consists in the performance of exercises capable of increasing the respiratory need, without pushing them so as to produce an extreme degree of breathlessness.

If we pass from physiological explanation to observation of facts, we see that practice gives a striking confirmation of theory.

Exercises of strength lead rapidly to an increase in the size of the thorax. It is the same with exercises of speed when they need very energetic movements. No exercise develops the chest as rapidly as does running, unless it be wrestling.

Mountaineers all have large chests, and the Indians who live on the high plateaus of the Cordillera in the Andes have been noted for the extraordinary size of their chests. This great development in mountaineers is due to two causes which act in the same direction: frequent ascent of steep inclines, and constant residence at great heights at which the air is rarefied. The climbing of these slopes needs a great quantity of work, which causes increase of the respiratory need; respiration in a rarefied atmosphere obliges a man to take deeper breaths in order to supplement, by the quantity of air breathed, the insufficiency of its vivifying properties.

Singers, with no other exercise but singing, acquire great respiratory power and a remarkable increase in the dimensions of their chests.

Numerous observations prove that it is enough voluntarily to take a certain number of deep breaths every day, to produce, in a short time, an increase in the circumference of the chest which may amount to two or three centimetres.

If we wish to gain the same result from muscular exercise, we must choose a form of work which will increase the intensity of the respiratory effort—that is, an exercise which brings powerful muscular masses into action. We shall thus perform a great quantity of work in a short time without producing fatigue. Now the legs, which possess three times as much muscle as the arms, can perform thrice the quantity of work before being fatigued. The lower limbs are, then, more capable than the arms of awakening the respiratory need, which is proportional to the expenditure of force.

Thus it is an error to demand from gymnastic exercises practiced with appliances, exercises of *suspension* or *support*, any development of the chest. The trapeze, the rings, the parallel bars, quicken respiration much less than running. These exercises cause an increase in the size of the muscles, and even of the bones of the regions which work, but they cause very little increase in the dimensions of the thorax.

Men who do much work with their arms have often a conformation which is very imposing at the first glance. They have sometimes broad shoulders; but if the arms have done the work alone, without the assistance of the muscles of the trunk, we easily see that the apparently large size of the thorax is due to an excessive development of the muscles about the shoulder-joint, and not to raising of the ribs.

Thus we are on the wrong road when we look for too ingenious means for developing the chest; this result, precious above all, can be obtained without any complicated appliances, without any difficult process; and if we had to formulate concise advice on this subject we should say:

When a young person has a narrow and flat chest, recommend running if he be a boy, or skipping if a girl.

CANADIAN ASBESTUS: ITS OCCURRENCE AND USES.

By J. T. DONALD, M. A.,

PROFESSOR OF CHEMISTRY, MEDICAL FACULTY, BISHOP'S COLLEGE, MONTREAL.

ASBESTUS is a singular mineral, whose characteristics are well indicated in the various names by which it is known. The French Canadian miners call it *pierre à coton*—i. e., cotton-stone. The Germans speak of it as *Steinflachs*, stone-flax; and *amianto*, the Italian name, indicates that which is undefiled, in allusion to the fact that it may be cleansed by fire. *Asbestus*, the name by which it is generally known, is a Greek word, signifying endless, ceaseless, and points to its fire-resisting properties.

Asbestus is, then, a mineral occurring in a fibrous form, the fibers being so fine and flexible that they may be spun and woven as cotton and flax are; and, moreover, the fabric so obtained is capable of resisting a very high temperature. Some varieties are said to have resisted a temperature of 5,000° Fahr. It must be noted, however, that although this mineral is infusible, except at extremely high temperatures, its fibers lose their flexibility and become brittle at a temperature only sufficiently high to deprive it of the water which forms a part of its composition.

By the mineralogist the term *asbestus* was originally applied to a finely fibrous form of hornblende; but, as Dana adds, much that is so called is a fibrous form of serpentine. Most if not all the asbestus of commerce is fibrous serpentine. A recent analysis made in the writer's laboratory showed the following composition:

Silica	39·05 per cent.
Magnesia	40·07 "
Alumina	3·69 "
Oxide of iron	2·41 "
Water	14·48 "
Undetermined	·30 "
	100·00

This mineral has been known from very early times, but it is only within recent years that it has found any extensive application in the various industrial arts. In ancient Greece the bodies

of those who were to be burned upon the funeral pyre were wrapped in asbestus cloth, that their ashes might be kept separate from those of the pyre. In the eighth century Charlemagne is said to have had an asbestus table-cloth, with which, when the feast was over, he was wont to amuse his rude warrior guests by throwing it into the fire, and in a short time withdrawing it cleansed and uninjured.

On the other hand, the first Canadian deposit was opened only in 1878, and the owners experienced considerable difficulty in disposing of their output, which for the season did not exceed fifty tons. In 1889, with a Canadian output for the year of nearly five thousand tons, the demand is in excess of the supply, and is increasing, with prices showing an upward tendency.

The asbestus of commerce is the product of two widely separated countries—Italy and Canada. The Italian article was first in the market, but the Canadian product soon made for itself a place and a name, and the mineral is now shipped from Canada to Italy; while toward the close of 1889 the United Asbestus Company, Limited, of London, England, which controls the Italian mines, acquired property in the Canadian field, and is equipping the same with a complete plant preparatory to operations on a large scale. It is very evident, then, that the Canadian fiber is, to say the least, no mean factor in the asbestus industry.

Canadian asbestus occurs in serpentine, being, as already explained, a fibrous form of this mineral. In two great geological formations represented in Canada there are extensive areas of serpentine, viz.—the Laurentian, which, beginning on the coast of Labrador, stretches westward beyond the Great Lakes; and the Quebec Group, a formation occupying a large portion of the province of Quebec lying between the river St. Lawrence and the United States boundary. In the serpentine of both these formations asbestus occurs, but as yet it has not been proved that the asbestus veins of the Laurentian serpentines are sufficiently persistent to warrant mining operations. It is not improbable that productive areas may yet be found in the Laurentian rock, as prospectors are now turning attention in this direction. But at present it is only in the serpentine of the Quebec Group that productive mining is carried on.

In this formation there is a belt of serpentine rock "which extends with tolerable directness, though with frequent breaks, northeastward from the Vermont boundary to some distance beyond the Chaudière River," which flows into the St. Lawrence near the city of Quebec. Throughout the whole of this belt there are indications of the occurrence of asbestus, but the present productive area comprises only a very small portion of this extensive belt. Although good workings occur elsewhere, the great majority

of the mines are along the line of the Quebec Central Railway, which runs from the city of Quebec to Sherbrooke, the capital of the so-called Eastern Townships of Canada, and cluster around two points a short distance apart and about midway between the two cities. In this district the serpentine forms a very rugged country, rising into bold peaks and ridges, the ruggedness and boldness being enhanced by numerous faults and dislocations of the rock. Bush-fires have recently passed over much of it, and the partially burned trees, with the scarred and seamed rocks as a back-ground, constitute a somewhat drear and dismal scene.

In the serpentine the asbestus forms irregular veins, varying from mere threads to four, six, and occasionally even more inches in width. The fiber is always at right angles to the sides of the vein, unless thrown otherwise as a result of faults. In some cases the mineral has been found concentrated in pockets, from which several tons have been taken. The color of the asbestus in the veins is white, greenish, or yellow, but near the surface the veins are frequently more or less discolored from infiltration through the shattered rock of water carrying oxide of iron. At a depth, and where solid rock is reached, this trouble usually ceases. The asbestus veins are frequently traversed by bands of foreign matter, such as compact serpentine, chromic and magnetic iron, and these, of course, lessen the value of the veins in which they occur, since they cut up the fiber and must be removed at considerable trouble.

Associated with the asbestus one usually finds a considerable quantity of coarsely fibrous mineral, for which, as yet, no use has been found, together with foliated and slaty forms of serpentine. Some of the latter are of very singular appearance. To use the words of an English gentleman who spent some time in the Canadian asbestus region, "Many of these fragments, as they lie on the ground after blasting, have so much the appearance of a wood-cutter's choppings that, if placed side by side with actual choppings from rough timber, exposed to the weather, the one could in no way be distinguished from the other except, of course, by handling." Others, again, in color and shape very much resemble strips of fancy confectionery.

Still another singular associate of the asbestus is a mineral of a white or green or yellow color, occurring in thin veins. When first exposed it is so soft that it may be easily indented by the finger-nail, but on contact with the air it soon hardens and assumes an appearance somewhat like porcelain. Analysis shows it to be closely related to serpentine.

Mining is carried on by cutting down the hills of asbestus-bearing serpentine, much as a farmer cuts down a stack of hay or straw, or by open quarrying on the level. The rock is blasted

out and the asbestus, separated from the containing rock, is "cobbed"—i. e., separated by hammering from adhering foreign matter. This "cobbing" is a comparatively easy matter in the case of the finer quality, as it usually separates readily from the gangue, but in the lower grades much difficulty is experienced in separating the fibrous matter from the non-fibrous. At best there is great waste. Much of the asbestus is in thin or narrow veins, and is wasted, as by the present mode of operating it does not pay to separate this from the serpentine. A machine that will enable these narrow veins to be utilized is a desideratum.

When "cobbed" the asbestus is graded according to purity, color, and length of fiber into three grades and bagged for shipment. The finest quality or "firsts" finds ready sale at prices ranging from $80 to $110 per ton; "seconds" fetch from $50 to $70 per ton; while "thirds" may be valued at $13 to $15 per ton. In good mines the yield of asbestus is from three to five per cent of the rock quarried, and the cost of mining may be put down at $25 to $30 per ton. Returns obtained by the Geological Survey of Canada show that, for the year 1888, Canada's output was 4,404 tons, valued at the mines at $255,000, and this the output of nine different mines. Over three fourths of the whole was shipped to the United States; small quantities going to Great Britain, Germany, France, Belgium, and Italy, and being used in domestic manufacturing.

Judging from the results obtained in the mines now worked, and the indications in other parts of the serpentine belt, it may be safely said that the asbestus deposits of Canada are well-nigh inexhaustible. There is every prospect that the industry will rapidly expand, as capitalists are turning attention to it, the work hitherto done "proving conclusively that mining for asbestus, when properly conducted, shows a more steady return for the money invested, with less elements of risk, than mining for any other known mineral."

Upon its non-conducting power and its ability to resist high temperature depend the many varied uses of the mineral. First and most important are its applications in connection with the steam engine and boiler. For packing pistons, flange joints, hot-air joints, cylinder-heads, and similar purposes, asbestus has proved itself invaluable, and for these purposes it is spun into yarn or wicking or rope, or made into mill-board. A large quantity is manufactured into a kind of felt, either alone or, in some cases, along with other fibrous material. Much of this asbestus felt is used as a non-conducting covering for steam-pipes. It is made into sections to fit any size of pipe, and into rolls and sheets for large surfaces. It is in use on the war-ships of the United States Navy, and has there and elsewhere been demonstrated to be supe-

rior to hair-felt as a non-conductor. By preventing radiation of heat from steam and hot-air pipes, this felt effects a large saving in fuel and gives dry steam at long distances from the boiler, and, by preventing excessive warmth of the boiler-house, adds much to the comfort of the workmen. The felt also finds application as a sheathing for covering wood-work in positions exposed to heat, and for fire-proofing flooring, shelving, partitions, and the like.

As far back as 1850 the Chevalier Aldini of Milan, experimented with asbestus, mainly with the object of turning it to account in the manufacture of asbestus cloth, but little success was met with until twenty years later. The unctuous character of the substance and the extreme fineness of the ultimate fiber are obstacles in the way of making asbestus cloth that shall be strongly coherent and not pull asunder easily. These difficulties appear to have been overcome to a great extent, and now in the form of woven fabrics there are many important applications of asbestus. To one of these, in particular, the attention of the public is frequently directed, because of the numerous fatal fires reported in theatres, music-halls, and similar places of entertainment. In the great majority of theatre fires the flames begin in the stage curtains or drapery. When these are made of asbestus, of course they are incombustible; or, if the curtain alone be of asbestus it affords a means of separating the stage from the body of the theatre, and, in case of fire in the former, prevents its spread to the auditorium. Asbestus curtains are now in use in the principal Roman theatres, and in many theatres in German, English, and American cities, much to the advantage of the theatre-going public. The mineral is also made into gloves, stockings, and other garments; in fact, complete suits of asbestus clothing can be obtained. In Paris the firemen of the city have recently been furnished with entire suits of asbestus cloth, and it is said to be probable that London will soon follow the example of the French capital.

In the form of gloves it is of much service to stokers and furnace-men, and as salvage blankets it is of great value. It is announced that mail-bags will, in the near future, be of asbestus. The frequent loss of mail matter by fire, in connection with railway accidents, renders it desirable that some incombustible material be used for this purpose.

Much of the lower grade of asbestus is ground up with other materials and made into cement and paint. The former is extensively used as a non-conducting covering for boilers and steam-pipes. Being a cement, it can not be readily removed without much labor and loss, so that it is somewhat less convenient than the felt, which, as already mentioned, is used for the same pur-

pose. It is, however, very much cheaper; and this, in the estimation of many, more than compensates for the less convenient form. Certain it is that much more cement than felt is used as a non-conducting covering.

The paint finds extensive application; a layer of it, while not rendering a wooden surface absolutely fire-proof, is yet proof against sparks and slight flames, and thus prevents the spread and increase of many an incipient fire.

In the form of rope it is used in the construction of fire-escapes and supports that may have to withstand fire. We have also asbestus paper. As a wall-paper it aids in rendering a building fire-proof. In the form of writing and printing paper it presents a fire-proof paper that may be used in valuable legal and commercial documents.

Not only does our mineral resist high temperatures, but it is also proof against the action of the majority of chemicals. It therefore forms a very valuable substance for use in filtering apparatus, especially where acid and alkaline liquids which corrode ordinary filtering paper and cloth have to be dealt with. As a filtering medium it is used not only in chemical laboratories, but in manufacturing establishments as well.

Though the asbestus industry is only in its infancy, many other uses might be mentioned; but, bearing in mind that it is possible to produce from it fire-proof fabrics of any form or shape, there will readily occur to the mind of the reader many other possible applications of this curious product of Nature's laboratory which has waited so long for an opportunity to minister to the comfort, convenience, and safety of man.

CHRYSANTHEMUMS.

By JEAN DYBOWSKI.

EVERY season has its peculiar flowers. Even in our extremely irregular climate there are few times in the year when we can not have some pretty blossom to admire. The explorations that are made into all the quarters of the globe, with importations that have followed them, have endowed our flora with such a number of varieties that we may say we have only to choose from among them to get the handsomest there are. There are few flowers that do not wear an infinite charm, and very few are those which fail to make an impression with their elegant form and fresh colors. Some among them, however, unite in themselves such combinations of qualities that they are lifted above their fellows, and occupy a place of honor among

us. Of these, those that are late in blossoming offer a special interest. Among the plants of this class which the public justly regards with the highest favor are the chrysanthemums. Few plants combine so many desirable qualities as they; abundance of blossom, richness in coloring, elegance of form, and long duration, are some of their leading qualities.

The plant has been known from very ancient times, and the beginning of its cultivation among us dates from several hundred years back; but it was for a long time neglected, and only a few varieties were known, whose small, imperfectly shaped flowers gave no indication of what could be made of them if special attention were given them. Now the varieties are counted by hundreds. Some have been directly imported from China and Japan, but the most of them are of French or English origin. Intelligent sowing and careful selections have given unanticipated results; and several types have been developed which are quite distinct in the form and arrangement of their flower-rays.

The flowers are originally of a similar disposition to those of the field daisies. By cultivation they have been made double—that is, all the minute flowers in the center have been endowed with large corollas like those constituting the white border of the daisy. Then the form of the corolla has varied so as to appear under very distinct types. Sometimes the petals curve upon themselves, so as to form a regular large head, as in what are called the Indian chrysanthemums. Others curve outward and give a more open form to the whole, as in the Chinese chrysanthemums. In others, again, the corollas deviate in every direction, constituting an odd, irregular type, but marked with a special artistic elegance, as in the Japanese chrysanthemums.

Chrysanthemums were formerly regarded as garden plants; they are equally house plants. There are few plants so well adapted to the ornamentation of our dwellings, whether they are treated as cut flowers or pot plants. For bouquets, only the orchis can rival them in lasting qualities. If cut in full bloom and kept in water, they will last two or three weeks; but the water should be renewed often, and kept pure with charcoal. Bouquets of exceeding elegance can be made of chrysanthemums. The flowers should be cut with as long stems as possible, and placed, after stripping the leaves from the lower ends, in a wide-mouthed vase (Fig. 1). The bouquet then has the appearance of a sheaf in which each flower displays its full beauty, and, by contrast of color and form, heightens the effect of its neighbor. A special business is made of growing flowers for these bouquets. In this cultivation all the flowers except the terminal one are suppressed on every branch, whereby the flower that is left reaches a large

size. The plants thus treated are cultivated under glass, and copiously manured in order to give them great vigor. Flowers have been thus produced measuring not less than twenty centimetres in diameter (Fig. 2). Assiduous care is given to all the details in raising these flowers. The petals are fashioned by hand, and are given the desired curvature, and put in determined positions by the aid of ivory pincers. A single flower thus produced will bring from two to four shillings.

FIG. 1.—BOUQUET OF CHRYSANTHEMUMS.

The effort to produce such exaggerated specimens can, however, not be regarded as a well-directed one. Overgrown flowers lose in beauty, and extreme regularity of shape is obtained at the expense of grace, and of the great charm of the flower, which lies chiefly in an unexpected novelty of form, and the special stamp of originality that gives each blossom an expression of its own. We might as well make them out of paper at once as treat them so that they shall all be alike.

FIG. 2.—LARGE CHRYSANTHEMUMS (reduced).

The November chrysanthemum exhibitions of the horticultural societies are growing in importnace. The superb plants that are now shown at them are counted by the thousand. The house of Levêque, which obtained the chief prize at a recent exhibition of the National Horticultural Society of France, had six hundred distinct varieties.

Europeans are not alone in their admiration of beautiful flowers. Some other people, having a fine artistic taste, entertain an enthusiasm for them that

rises to a passion. With the Japanese, who love flowers above every other decoration, the chrysanthemum holds the place of honor, and, as the golden chrysanthemum, is the highest national decoration. It is usual with them to name women after flowers, and "Madame Chrysanthemum" is much favored. A custom prevails among them at chrysanthemum-time of covering human

FIG. 3.—JAPANESE MANIKINS, PLASTERED AND DRESSED IN CHRYSANTHEMUM FLOWERS. (From a photograph.)

figures with a coating of clay and arranging chrysanthemums upon them, in colors, in imitation of their dress-goods; these manikins may represent men playing some scene of action (Fig. 3), or women making or offering tea (Fig. 4). The figures are placed on exhibition, and an admission fee is charged for seeing them.

Not all chrysanthemums can be cultivated here in the open air. Some of the choicest varieties, true to their Eastern origin, are too tender for our chilly autumns, and need to be sheltered. But they pay well for the attention, by preserving a brighter verdure, and fresher and more brilliant colors. Some effort has been made, by heading in and otherwise trimming the plants, to make them grow into particular shapes, but the practice has not become very extensive.

Chrysanthemums thus combine the advantage of blooming in the autumn and late into the winter, and submitting to various trimmings, and assuming diverse aspects. The cultivation of

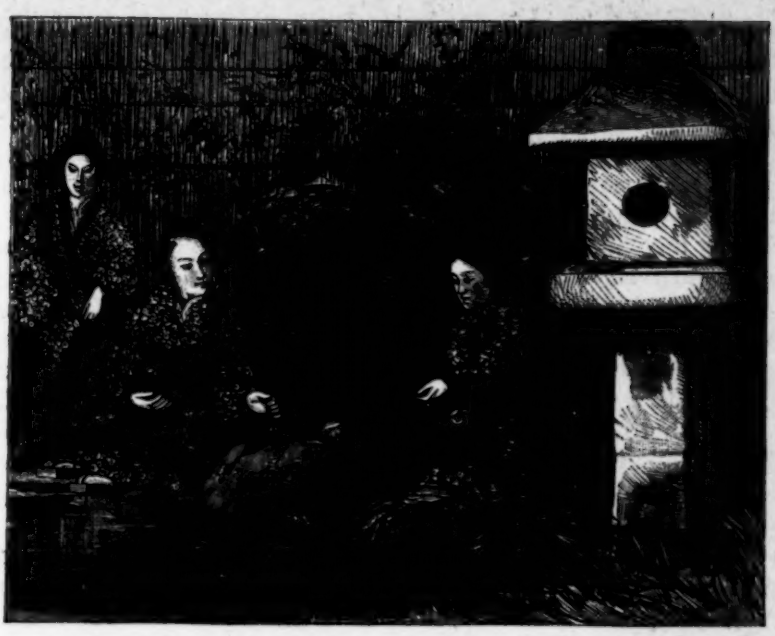


FIG. 4.—JAPANESE MANIKINS, DRESSED IN CHRYSANTHEMUMS, REPRESENTED AS MAKING TEA. (From a photograph.)

them will, no doubt, go on increasing, for they are justly, on account of the many desirable qualities they combine, appreciated very highly.—*Translated for the Popular Science Monthly from La Nature.*

RAINFALL ON THE PLAINS.

By STUART O. HENRY.

THE general impression seems to be that the rainfall has increased and is increasing on our "plains" because of their settlement and cultivation. It is fancied that, as the population moves westward, augmented precipitation follows, so that there is now sufficient rain where ten or twenty years ago it was too dry. Travelers who ride swiftly across this region in a day find towns and catch glimpses of farming operations where five years ago they saw but a barren waste. They conclude that a marked climatic change has taken place, and infer that it can only be due to the presence of population. They fancy that the cultivation of the land must produce marked hygrometric results. That this is a remarkable fallacy becomes certain when attention is called to the evidence.

In the first place, neither history nor science gives any testimony to show that the tillage of the soil and the planting of trees

have any appreciable, to say nothing of a considerable, effect on the climate. Even in irrigated countries only a barely perceptible increase in the rainfall has been discovered. In Spain, France, and Italy, irrigation is now not only required for farming, but it is more widely practiced than ever before; yet, if the "rain-belt" theory were correct, these countries would long ago have had sufficient precipitation for successful agriculture. There is scarcely any rainfall in the valley of the Nile to-day, after centuries of cultivation and of annual floods.

Our "plains," or arid region, lie east of the Rocky Mountains, and are at least four hundred miles across. Although the precipitation gradually decreases as one proceeds westward from the Missouri River, it is difficult to fix an isohyetal line. But the line is somewhere between one hundred and two hundred miles west of the Missouri, as the flora clearly shows. It seems to have been taken for granted that the plains were treeless and well-nigh grassless because of lack of rain. Whether the absence of trees is ascribable to the pulverulence of their soil, or the germless lacustrine deposit which covers them, or the excess of moisture, or the fires of the Indians, it is clear that it is not due to rainlessness, because the dry hill-tops in the midst of the arid region have some trees. In other words, there is no evidence whatever that the precipitation on the plains to-day is any greater than it was fifty or one hundred years ago; and there is every reason to believe that it is less.

But, it is said, the observations west of the Missouri show a material increase in the rainfall. This is not true. In the reports of the Kansas State University and the Kansas State Agricultural College we learn that the rainfall for the ten years from 1879 to 1888 is not so great as that of the previous decade. One authority on the subject has recently taken, among other series, the observations at Fort Leavenworth from 1837 to 1883, and, testing by the proper mathematical processes their variabilities and probabilities, demonstrates that there is no indication whatever of permanent climatic change. Yet Fort Leavenworth is one hundred and fifty miles east of the eastern line of the dry region.

It must appear irrational to any one, after a moment's reflection, that the settlement of five or six thousand people in a county usually twenty-four by thirty-six miles in dimensions, and the tillage of a small part of its area, would so materially increase the rainfall in the brief period of ten or twenty years as to make agriculture successful and profitable where before it was not possible. Extending these limits to the wide expanse of States does not make the idea any more tenable. Yet on such conditions as these the theory as applied to our plains is based. The reports of

the Nebraska and Kansas Boards of Agriculture will show that, in the territory lying west of the ninety-eighth meridian in those States, the acreage of land actually under cultivation, when compared with the whole area of that territory, is almost insignificant. The climate, as well as the law, pays no heed to small things.

It would not answer for the advocates of the theory only to claim that precipitation would be augmented *somewhere*, and not necessarily in the certain region where is found the increase of farmed lands; for it would then be very reasonable to suppose that the prevailing southwest and west winds of the plains would drive from them the moisture which the farmer there had earned. Iowa, Missouri, and eastern Kansas, instead of the dry region, would get the increased rainfall.

Prof. Frank H. Snow, of the Kansas State University, said several years ago: "But the fact that thousands of new-comers, from ignorance of the climate, have attempted to introduce ordinary agricultural operations upon the so-called plains, and have disastrously failed in the attempt, has placed an undeserved stigma upon the good name of Kansas in many far-distant communities, and has undoubtedly somewhat retarded immigration during the past few years. It is time for the general recognition of the fact that, except in the exceedingly limited area where irrigation is possible, the western third of Kansas is beyond the limit of successful agriculture." The severe seasons of drought which have occurred since the above conservative statement was written show the whole truth of the matter to be that the westward advancing line of settlement is by no means an isohyetal one, but that it is merely a line representing in a way the overflow of the population of our Eastern States. It needs but a slight acquaintance among the old settlers in central Kansas to know that they fear nowadays excessively dry weather as much as they did twenty-five years ago. The people who live farther west are losing faith in the idea of an increased rainfall, as is evidenced by the fact that over two hundred linear miles of main canals have lately been constructed for irrigation purposes nearly as far east as Kinsley, in the Arkansas Valley of western Kansas. In the Platte Valley, in Nebraska, large irrigating systems are at present being projected.

He who would provide the plains with an ample precipitation must remove the Rocky Mountains. Is it reasonable to suppose that three or four telegraph lines, small bunches of stripling trees here and there, and the turning over of a few thousand acres of sod, can be of any avail in changing a great dry territory into a garden? Can man so easily control Nature and her laws? Certainly not. Climates are immutable so far as the puny efforts

of humanity are concerned. And it is a grave fallacy, for on the strength of it hundreds of families are induced each year to locate on the plains with the expectation of farming successfully. Failure follows, of course, and their only hope is to sell out to trustful new-comers, and move where the natural conditions are favorable to agriculture and the prosperity of farm-homes.

LONG FASTINGS AND STARVATION.

By M. CHARLES RICHET.

WHAT takes place in an animal deprived of food may be explained by recurrence to the comparison between the animal and the machine, which, though very old and commonplace, is still exact and almost inevitable. In the machine, the burning of carbon gives rise to heat and force; animals also, burning carbon, develop heat and force. The same is true of plants, for they likewise disengage heat and force; only the plant disengages very little, and the animal much of them. While the plant is stationary, fixed to the ground, the animal is forced to move to find food. We might, indeed, say that all its wonderfully complicated organism is in substance only an apparatus attached to the stomach. The lower animals are hardly anything else than a stomach adapted to motion; and the animal is improved as its means of seeking food everywhere and at a distance are perfected. The animal goes out in search of food because it feels a want—hunger. Nature, in fact, distrusts the intelligence of her children, and for that reason has given to all living beings instincts and wants; and has armed them all, without exception, with the sensation of hunger, to provoke them to seek nourishment. Without this irresistible feeling no being could live.

The sensation of hunger is a painful feeling of uneasiness and weakness. It is a general feeling, but is localized apparently in the stomach. Many ancient authors regarded it as a local sensation. Some said that the gastric fluid became more acid and produced a burning feeling in the stomach; others, that a contraction of the stomach took place. But, although the sensation of hunger is related to the stomach, it is really general. While it is sometimes alleviated by swallowing earth and stones, such inert substances may deceive it, but do not appease it. It has, moreover, been experimentally determined that the feeling of hunger is not abolished after cutting the pneumogastric or sensitive nerve of the stomach.

So, in thirst we feel a dryness in the back part of the throat. The local sensation is deceptive, for thirst does not depend upon

any condition of the mucus of the pharynx. It is caused by the exhaustion of the watery elements of the blood. It is therefore removable by injections of water, and by bathing, when water is absorbed by the pores.

If hunger is not satisfied, it disappears after a certain length of time. The most intense suffering is endured during the first twenty-four hours, after which the pain diminishes. The characteristic phenomenon exhibited by an animal subjected to starvation is the constant diminution of weight. I have made many experiments on this loss, comparing animals of various sizes, and have determined that the function of dehydration—or reduction of weight—is in direct relation with the size of the animal; and I believe that I can deduce a great rule of comparative physiology that the activity and intensity of all the functions are determined by size. Carnivorous animals appear to bear fasting better than herbivorous kinds. The latter eat nearly all the time, and are ill when they have to stop; but carnivorous animals, in the wild state, are often forced to endure abstentions of considerable length; and a fast of several days is almost a physiological condition with them.

When we examine the phases of the loss of weight of a starving animal, we find that it loses much during the first days. Then a moderate drain sets in. Again, in the last days considerable loss takes place, and this is the forerunner of death.

Cold-blooded animals can support inanition during a prodigiously long time. M. Vaillant has told me of a python weighing seventy kilogrammes that lived twenty-three months without eating; M. Colin, of a rattlesnake that lived twenty-nine months. Redi mentions a tortoise that lived eighteen months, and a frog sixteen months, without food. When we have frogs in our aquariums waiting to be experimented upon, we never feed them and they never starve. Dogs can endure abstinence, on the average, of thirty days; cold-blooded animals, twice as long. They are capable of this, because their tissues are consumed more slowly, and do not require so frequent renewing. With both classes the fatal limit is reached when the loss of weight amounts to forty per cent. This point is reached by the warm-blooded animal ten times as quickly as by the cold-blooded one, because its nervous system is ten times as active. The relation of the nervous system to the intensity of the chemical exchanges of vital action is shown by the existence of hibernating animals, or warm-blooded animals which periodically become cold-blooded. Becoming torpid at the approach of the cold season, their breathing and circulation become slow, their motions weaker, their eyelids close, they fall into their winter sleep, and their temperature descends to about 40° Fahr.

The nervous system is the great inciter of nutrition: when it is vigorous or excited, the digestion is active, the breathing rapid, and the temperature high; and the loss of weight and the possible duration of abstinence follow the same rule.

Man is subject to the same conditions in case of fasting or starvation as warm-blooded animals; and the influences of size, age, and nervous constitution are similar upon him. This is illustrated, in respect to age, in the legend of the family of Ugolin, in which the youngest child died first, at eight years of age, and the other children followed, while the father did not die till three or four days after the death of the last of them. So, in the wreck of the Medusa, the children died first on the raft, the old men next, and the adults last. We might have supposed that the old men would have resisted better; but while they may, perhaps, bear moderate fasting with less inconvenience than more active persons, they are less able to endure starvation. New-born infants are less capable of resistance than adults; but the young of animals—puppies and kittens—are more hardy than we would be ready to suppose. Experiments on new-born children have shown that they can offer considerable resistance to external influences, provided they are well fed. Their mortality is principally due to a deficiency of alimentation called athrepsy, infants dying of which present the same lesions as starved animals. Their fat is exhausted, while the weight of their nervous system is not reduced. Another feature of the starvation of infants is a relative increase in the globules of the blood by dehydration; not that the number of globules is greater, but the proportion of them to the whole volume, a considerable portion of the water having disappeared.

The duration of the possible fast is considerably influenced by fever. That is supposed to determine the production of poisons which stimulate the nervous system and intensify the process of denutrition; so that under its influence, as has been observed in experiments on animals and in man, the weight diminishes more rapidly than under starvation alone.

The influence of drinking is also noticeable. Of two dogs observed by M. Laborde, one died in twenty days; the other, which could drink at will, was still living at the end of thirty-seven days. There are also examples on the other side. Falck's dog went sixty-one days without drinking or eating. Starving dogs usually drink but little, as if warned by instinct not to drink more than they have to. Water, in fact, expedites the wasting of the tissues and accelerates the drain of the salts in the organism. Hence, by drinking, we excrete more chloride of sodium, phosphates, urea, etc., so that, although in general animals deprived of water do not live as long as those which can drink, there is

some difference between those which can drink a little and those which drink a great deal. The last die sooner.

There is always less suffering when it is possible to drink; for it is a characteristic of privation that thirst torments more than hunger, and those who have told of what they have suffered on such occasions have usually emphasized this fact. But I do not believe that the hour of death is much delayed by the ingestion of drinks.

In considering cases of fasts endured by men, we have to distinguish between the *experimental fast*, carefully arranged for and limited to a certain number of days; the fast which I call *charlatanish;* and the *compulsory fast*, which is inflicted upon persons who have been surprised by accidents, such as shipwrecks or land-slides, or who have been left in the wastes of the desert.

EXPERIMENTAL FASTS.—Mr. Ranke, a German physiologist, felt no great inconvenience for forty-eight hours, and his worst sufferings were in the earlier stage. His symptoms were great muscular weakness, impossibility of sustaining prolonged movements, fibrillary shiverings, and headache. The most striking phenomena were insomnia with nightmare and throbbing in the head. Beginning nineteen hours after he had taken his last food, he determined by experiment what was his daily diminution of weight, and the rate of consumption of carbon and nitrogen per kilogramme and per hour. He found that the consumption of carbon was twenty times that of nitrogen; that he lost in weight about 1·2 gramme per kilogramme per hour; and that he produced fourteen litres of carbonic acid per kilogramme per hour. The last number is important. In the normal condition we produce eighteen litres of carbonic acid per kilogramme and per hour. As Mr. Ranke's case was not one of illness or any kind of weakness, the question arises as to the purpose served by these four litres of surplus carbonic acid. The most obvious answer is that they are a luxury. In some experiments which I made, the rate of production by my subject, while fourteen litres during the fast, rose by one third after he had eaten a hearty meal, and his respiration increased in a like proportion.

In the cases of the celebrated fasters Tanner, Succi, and Merlatti, while it may be hard to prove that there was no fraud, the precautions taken against it seem to have been ample to make it extremely improbable. They, moreover, all endured their fasts under special conditions. Merlatti ate a fat goose, bones and all, before beginning; Succi took a drink to which he attached great importance. The diminution of weight was less considerable than in the other subjects mentioned, but in Merlatti's case the whole amounted to twenty-seven per cent at the end of the fifty days,

and there was great danger of a fatal result from the enfeeblement of the nervous system. The faster persisted in going on to the end, after being advised to discontinue the experiment, and vomited immediately after taking the first food. Nevertheless, he presided at a banquet given in his honor, and fully recovered in two months. Cetti, whom M. Senator put on an experimental fast of ten days, and who drank all the water he wanted, lost more weight during the first than during the second five days.

In view of other facts showing less capacity to endure long fasts, we have to conclude that such persons as Tanner, Succi, and Merlatti performed their experiments under exceptionally favorable conditions. They had no severe weather to face, no concern about their fate, and knew that they had only to make a sign to have a savory repast brought to them. Quite different is the situation of persons who have been buried, for example, under landslides. Cut off from the rest of the world, they know that no help can come to them for the moment, but that to reach them tunnels must be bored and large masses of earth and stones removed. Long privations of food have often to be suffered under such conditions. Berard mentions men who were confined for fourteen days in a damp cellar. Licetus was shut up for seven days. The miners of Bois Mousil were confined for eight days after a landslide, without suffering greatly.

Other examples are afforded by shipwrecked persons. There is an interesting story of a party wandering on the ice-fields who were exposed to a terrible cold for seventeen days, in 1809, without other nourishment than water thawed from sea-ice. When found, their skin was sticking to their bones, their eyes were sunk deep in their orbits, and they had fetid breaths and earthy complexions, their skin was covered with a sooty scurf, and their tongues were black. This sooty aspect of the skin is a common symptom in great famines, such as occur in India and China.

We have many instances of individual fasts. An Italian seventy-seven years old, mentioned by MM. Monin and Maréchal, lived without food to the thirty-seventh day, only drinking occasionally a little brandy and water; then went to eating again without feeling any inconvenience. A man named Granie, condemned to execution, starved himself to death in sixty-three days. Antonio Viterbi, in 1821, allowed himself to die of hunger in order to escape the penalty of death. He had also resolved not to drink; but at one time, taking water in his mouth to refresh himself, he could not restrain himself and swallowed it. He had vertigo and nightmare, but suffered most from thirst, and died on the seventeenth day. This period, from seventeen to twenty days, represents the mean duration of life of a man in normal conditions who is starving. But Simon Goulart tells of one

Hasselt who was found alive after having been shut up for forty days without food.

Succi and Merlatti were perhaps insane or melancholy. Persons who are taken in good health resist less effectively than maniacs. M. Lepine cites the case of a girl who had constriction of the œsophagus, who died after having lived sixteen days without food or drink. There is also the extremely interesting case of a German merchant who, having been unfortunate, went into the woods to starve himself to death, and died after eighteen days. He was still breathing when discovered. He had noted down his impressions daily. After five days he wrote: "If I only had fire, a little fire! How long the nights are—how cold they are!" On that day he drank. Three days afterward, cold water which he tried to drink made him vomit. A week after that he tried to go to the water, but his strength failed him and he stuck to his resting-place. During these eighteen days of suffering he therefore drank only once. These periods of nineteen, seventeen, and sixteen days, in persons not out of their minds, justify the estimate of twenty days as the length of the fast which will bring death to healthy persons under no nervous waste. But the time admits of a considerable extension among insane persons and those who have made preparations for their fast. Succi, who fasted thirty days, had been twice in an insane asylum. Cardan relates the case of a Scotchman who lived thirty days in a prison without eating. Devilliers, in the "Journal de Médecine," mentions an insane person who died after seventy-five days of partial fasting, in which he took only a few glasses of liquid—a little wine and bouillon. The amount of weight lost at death can not be closely determined, but may be estimated at about thirty per cent.

These conditions relate to sound or nearly sound persons. Respecting the stories told of diseased persons, we have to steer between a Scylla and a Charybdis of excessive credulity and excessive incredulity. A Prof. Licetus, of Padua, near the beginning of the seventeenth century, wrote a rather stupid folio in Latin, "On those who can live a Long Time without Food." It contains various chapters, on "those who live eight days"; "those who live a month"; "those who lived three months"; "those who lived from one year to eight years"; "those who lived more than twelve years"; and ends with the story of the seven sleepers of Ephesus, who went to sleep in the reign of the Emperor Decius and woke in that of Theodosius. We can more than doubt some of the stories of Licetus; but there are facts as remarkable as some of them, concerning long fasts by diseased infants and girls, which we can not question.

The excessively long fasts, whether experienced by men,

women, or children, have usually been observed in hysterical persons—for it is now known that hysteria exists in men and children as well as in women. Taking up almost any of the numerous stories related by the old authors, we find manifest traces of hysteria in them. Here, for example, is "the memorable and prodigious history of a girl who for many years neither ate nor slept nor voided, and yet lived by God's admirable grace and virtue" (Frankfort, 1587). She was Catherine Binder, of Heidelberg, who at twenty-seven years of age all at once lost the taste for warm food (a hysterical fancy), and ate nothing warm for five years, when she was treated by a quack, and also lost the taste for cold food. She neither ate nor drank for seven years. While we may entertain some question respecting the accuracy of this affirmation, there is no doubt that the girl was nervously affected. She had been deprived of hearing and speech for three years; she had spasms when she tried to eat, so that she could not swallow; and, during two weeks that she was watched, she neither ate nor drank. Another girl (1586), religiously affected in her hysteria, was taken with an aversion to everything eatable, and a difficulty in swallowing, and lived for four years on nothing but water and, at long intervals, a little bread dipped in water. Apollonia Schrierer, of Berne (1604), lay physically insensible but wide awake day and night. She was kept apart from her mother and constantly watched by the officers for two weeks, during which she took no food. In the same book with this story is that of a girl of Spires, watched for twelve days, who was assumed to have lived for three years upon nothing but a few drops of water or wine, which she took in her lips. She was twelve years old, and slept most of the time. A girl of Cologne, who lived four years without food, fainted whenever they tried to put anything into her mouth. Passing over several other cases related by these old authors, which vary but little in their general features, we come to a number of cases recorded in medical publications of the eighteenth century, in all or nearly all of which the long fast is accompanied by some kind of disorder of the body or mind. In many of these instances, as in some of those described above, the fast was not absolute, but was occasionally relieved by the introduction of a few drops of milk or broth. Such a fast can be continued indefinitely—as in the case of a woman described by Vandermonde in 1760, who lived thus for twenty-six years.

The present century furnishes numerous fairly well authenticated instances of extraordinarily long fasts, which were nearly always associated with some form of hysteria. We can not mention them all here, and omit those which are most frequently cited in the medical books. Anna Garbero is described by Ricci as having, after a sleep without eating of forty days, been taken,

on the 8th of September, 1825, with an absolute repulsion against food, and thus continued till the day of her death, after a lethargic sleep of three months, on the 19th of March, 1828. The autopsy disclosed a contraction of the sigmoid flexure of the colon. One of the most extraordinary cases on record is that of the Dutch hysteric Angelina de Vlies, forty-one years old, who continued without food from the 10th of March, 1822, to 1826. She was subject to cramps and tremors, and was very weak, and not able to rise without help. Bourneville and D'Olier tell of an idiotic child who at two years of age lived three weeks, and at seven years twenty-eight days, on nothing but water and broth. In many similar cases, the patients have eaten occasionally, but only the minimum quantity indispensable for the maintenance of life. Thus, a woman cited by Laségue only ate during a year what an ordinary person would require for two days.

One of the characteristics of cases of this kind is the extraordinary perversion of appetite. An insatiable craving prevails in some of the patients, a loathing in others. Perversions of the sexual passion have also been remarked. With these fantastic tastes is associated an exceptionally strong and enduring power of resistance.

There was for a long time at the Salpêtrière a woman named Etchverry, who had hemiplegia on one side and contracture on the other. Her hysteria should apparently have provoked a general denutrition, but it did not. She would not eat, and had to be fed artificially. Her excretions were marked by an extreme deficiency of urea. There was no deception in her case, for she was under constant watch.

I have observed in a very precise experiment the diminution in the phenomena of nutrition in hysterics. M. Hannot and myself, studying two hystero-epileptic cases at the Salpêtrière, found that the patient in a condition of lethargy received only four litres of air into her lungs in sixteen minutes, and made only eight inspirations in thirty-six minutes. This marvelous slackening of the respiratory phenomena constitutes a real hibernation in man, resulting from the absence of stimulation of the nervous system.

Observations have been made of a disease of somnolence. M. Charcot has recently published an account of a case, and MM. Semelaigne and Gélineau have published another. An irresistible torpor takes possession of the patients, who fall into a sleep in which all the phenomena of nutrition are slackened, but the sleepers wake occasionally and take food or perform physical offices.

The fakirs of India, who allow themselves to be buried alive, belong to the same category. They submit to extraordinary mortifications, eat but little, abstain from meats, and use curious arts to empty their stomachs. Having hypnotized themselves, they

rest almost without breathing. While much of this may be imposture, there are, according to Rousselet and Jacolliot, some well-authenticated cases of the kind. English sentinels were set around one fakir who was buried alive. When disinterred he was apparently dead, but was aroused and lived. I do not consider it necessary to question the correctness of the cases of lethargy and apparent death recorded in the books. A considerable depression of the nervous system accompanies all such phenomena, and the activity of the heart and the rhythm of respiration disappear at a certain stage of the disease.

There have not been many experiments on this subject made upon men. We have one, however, from M. Debove, on the influence of suggestion upon hysterics. On his indication to two patients that they should not eat or drink, they comfortably supported a fast of fifteen days, with only slightly proportionate decrease of weight, and they had had hardly any feeling of hunger at the end of the period. For comparison, M. Debove tried to impose a fast on a vigorous man, but was obliged to suspend it after five days. This subject lost at the rate of 0·8 gramme per kilogramme per hour, against 0·13 gramme in the hysterical patients. He was not susceptible to suggestion.

We draw from these facts that the functional exchanges are retarded in cases of hysteria. We do not yet know the exact influence of the nervous system. There is certainly a diminution of chemical activity in the tissues which produce heat and in the glands that furnish the secretions. This is not saying much, but it is something.—*Translated for the Popular Science Monthly from the Revue Scientifique.*

SKETCH OF JAMES GLAISHER, F. R. S.

METEOROLOGY owes to Mr. Glaisher the results of many years of patient labor at the institutions and observatories with which he has been connected; a series of valuable researches undertaken at the instance of the British Association; and those daring and brilliant observations in a balloon at very great heights in the atmosphere with which his name is most conspicuously associated. Yet, as has been observed by one of his biographers, "his numerous contributions to scientific and popular literature, often published in a most unobtrusive manner, which is very characteristic of the man, have scarcely gained him so wide a reputation in the learned world as he certainly deserved."

JAMES GLAISHER was born, according to the "Men of the Time," in London in 1809. In 1829, as assistant in the principal trian-

gulation of the ordnance survey in Ireland, he was charged with the meteorological observations on the Bencorr and Keeper Mountains. These observations were published in 1836. From 1833 to 1836 he was assistant at the Madingly Observatory, near Cambridge; was appointed in the latter year assistant in the astronomical department of the Greenwich Observatory; and was made in 1840 Superintendent of the Magnetical and Meteorological Departments of the same institution, where he remained till he retired from the public service at the end of 1874. In 1865, upon the death of Admiral Fitzroy, he was appointed to the control of the meteorological department of the Board of Trade. From 1841 till very recently he has contributed to the registrar-general's reports the quarterly and annual meteorological reports embodying the results of the reductions and discussions of the observations of about sixty voluntary observers scattered over England.

Among Mr. Glaisher's earlier contributions to the literature of meteorology were the "Hygrometrical Tables," first published in 1845, which has passed through six editions, and is regarded as a fundamental work in connection with the science; "A Memoir on the Radiation of Heat from Various Substances," 1848; certain papers on the forms of snow-crystals, 1855; a report on the "Meteorology of London during the Cholera Epidemic of 1853–'54," published by the Board of Health in 1855; and a report on the "Meteorology of India in Relation to the Health of the Troops," 1863, which formed an appendix to the report of a Royal Commission on the Army in India. In 1857 he conducted the experiments and wrote the report of the Royal Commission on the Warming and Ventilation of Dwellings. He was the founder of the Royal Meteorological Society, of which he was the secretary for nearly twenty years, and the president in 1867–'68. He is a past President of the Royal Microscopical Society.

As a member of the British Association he has been active in the meteorological researches undertaken under the direction of that body; and we find his name attached year after year to the reports on "Luminous Meteors," "Rainfall," "Rate of Increase of Underground Temperature downward," "Circulation of Underground Waters as related to the Water-Supply of certain Towns and Districts," and "Mathematical Tables." The reports on "Luminous Meteors" were particularly minute and exhaustive. They seem to have been intended to include as full and accurate accounts as it was possible to get of every meteor that fell anywhere on the earth within the view of a man intelligent enough to describe it; and they embody frequent suggestions as to the direction which future research might take. Thus, the report of 1874 noticed the apparent connection between some meteor-show-

ers and certain comets, and spoke of the coincidences as being numerous enough and sufficiently exact to render desirable the further cultivation of cometary astronomy by star-shower observations. The report of 1875 pointed out that the work of properly treating meteor observations had become so great as to be beyond the power of the Association to grapple with it, and commended the arrangements which M. Leverrier was making for that study. In 1878 the committee, finding it probable that the highest attainable accuracy in mapping the observed directions of the apparent paths of shooting-stars was the real key to the solution of the problem presented by their nightly flights, and that the question of the possible connection of fire-balls and aërolites, or large stony masses, with such showers—and accordingly, it might be, in certain cases, with comets—depended for its solution on accurate observations of these meteors, recommended the study as an attractive one, and gave a series of directions for following it up.

A committee was appointed at the Aberdeen meeting of the British Association in 1859 to make observations, by means of a balloon, in the higher regions of the atmosphere. Nothing was done for two years, for want of a balloon and an observer. The committee was reappointed at the Manchester meeting in 1861; a balloon was contracted for with Mr. Coxwell, an expert aëronaut, and Mr. Glaisher, the most active member of the committee, volunteered to go up with him and make the observations. Twenty-eight ascents were made from Wolverhampton, the Crystal Palace, and other places not far from London, between the 17th of July, 1862, and the 26th of May, 1866, of which seven were made into extraordinarily high regions, from 22,884 feet to 37,000 feet, or seven miles. In all these ascents, Mr. Glaisher remarks, in the introduction to "Travels in the Air," "I used the balloon as I found it. The desire which influenced me was to ascend to the higher regions and travel by its means in furtherance of a better knowledge of atmospheric phenomena; neither its management nor its improvement formed a part of my plan."

The first ascent was marked by meeting a warm current at a great elevation. Clouds were entered at 4,000 feet, which proved to be also 4,000 feet thick. The temperature at starting being 59° Fahr., fell to 45° at 4,000 feet, and to 26° at 10,000 feet, from which it remained stationary up to 13,000 feet. Then it rose to 31° at 15,500 feet, and 42° at 19,500 feet, after which it fell rapidly to 16° at 26,000 feet.

In the ascent of September 1, 1862, the curious phenomenon was observed of the formation of clouds along the course of the Thames from the Nore to Richmond. The clouds followed the river in its course through all its windings, not departing from it

on either side. It being about the time of high water, the formation was supposed to be the effect of the warm current coming up from the sea.

On the 5th of September, 1862, the aëronauts reached the height, which has never been surpassed by man, of 37,000 feet, or seven miles. Mr. Glaisher thus described his experiences after making his observations at 29,000 feet: "Shortly afterward, I laid my arm upon the table, possessed of its full vigor, and, on being desirous of using it, I found it powerless—it must have lost its power momentarily. I tried to move the other arm, and found it powerless also. I then tried to shake myself, and succeeded in shaking my body. I seemed to have no limbs. I then looked at the barometer, and while doing so my head fell over my left shoulder. I struggled and shook my body again, but could not move my arms. I got my head upright, but for an instant only, when it fell on my right shoulder, and then I fell backward, my back resting against the side of the car and my head on its edge; in this position my eyes were directed toward Mr. Coxwell in the ring. When I shook my body I seemed to have full power over the muscles of the back, and considerable power over those of the neck, but none over either my arms or my legs; now, in fact, I seemed to have none. As in the case of the arms, all muscular power was lost in an instant from my back and neck. I dimly saw Mr. Coxwell in the ring, and endeavored to speak, but could not; when, in an instant, intense black darkness came; the optic nerve finally lost power suddenly. I was still conscious, with as active a brain as at the present moment while writing this. I thought I had been seized with asphyxia, and that I should experience no more, as death would come unless we speedily descended; other thoughts were entering my mind, when I suddenly become unconscious as in going to sleep. I can not tell anything of the sense of hearing; the perfect stillness and silence of the regions six miles from the earth (and at this time we were between six and seven miles high) is such that no sound reaches the ear." During this time Mr. Coxwell was in the ring above the car, trying to open the valve. He also lost the use of his hands, and was obliged to seize the cord with his teeth and pull it by dipping his head. Consciousness returned gradually to Mr. Glaisher, and no inconvenience followed the insensibility; and when the party had landed, no conveyance being available, they were obliged to walk several miles.

In the ascent of June 26, 1863, the party passed through layer above layer of clouds to the height of four miles; in the descent, they passed through a fall of rain, and below it a snow-storm, the flakes of which were composed of spiculæ of ice and innumerable snow-crystals. On reaching the ground the atmosphere was

thick, misty, and murky, and the afternoon cold, raw, and disagreeable for a summer's day.

The observations made during night ascensions, or those which were continued into the night, on temperatures at different heights, gave results different from the theories previously held on the subject. An increase of the temperature with the height was noticed after sunset. The rate of decline of temperature with elevation when near the earth was subject to variation as the sky was clear or cloudy. From an elevation of three miles cirrus clouds were seen apparently as far above the observers as they seem when viewed from the earth, and that under such conditions that it was hard to believe that their presence was due to moisture. The audibility of sounds from the earth depended considerably on the amount of moisture in the air. The noise of a railway train could be heard in clouds at four miles high, but not when the clouds were far below. The discharge of a gun was heard at 10,000 feet; the barking of a dog at two miles; but the shouting of a multitude at not more than 4,000 feet. Many differences in the results of observations were supposed to depend upon atmospheric conditions, while these vary with the time of day and the season of the year; so that a great many observations would be required to determine the true laws. Having followed up one of the observations recorded above with a captive balloon and by other means, Mr. Glaisher declared to the Meteorological Society, in 1870, that the theory that the temperature is always lower at higher elevations is not true.

Some noteworthy mental impressions are recorded in Mr. Glaisher's descriptions of his ascents. Writing of his feelings at the height of 23,000 feet, and under the imminent necessity of descending at once, he was surprised "at the extraordinary power which a situation like this calls forth, when it is felt that a few moments only can be devoted to noting down all appearances and all circumstances at these extreme positions; and if not so rapidly gleaned they are lost forever. In such situations every appearance of the most trivial kind is noticed: the eye seems to become keener, the brain more active, and every sense increased in power to meet the necessities of the case; and afterward, when time has elapsed, it is wonderful how distinctly at any moment scenes so witnessed can be recalled and made to reappear mentally in all their details so vividly that, had I the power of the painter, I could reproduce them visibly to the eye upon the canvas." A fine description, of which we can quote only a part, is given of the scenery of the upper air: "Above the clouds the balloon occupies the center of a vast, hollow sphere, the lower portion of which is generally cut off by a horizontal plane. This section is in appearance a vast continent, often without intervals

or breaks, and separating us completely from the earth. No isolated clouds hover above this plane. We seem to be citizens of the sky, separated from the earth by a barrier which seems impassable. We are free from all apprehension such as may exist when nothing separates us from the earth. We can suppose the laws of gravitation are for a time suspended, and, in the upper world to which we seem now to belong, the silence and quiet are so intense that peace and calm seem to reign alone." The descriptions of sky and cloud scenes that follow are very picturesque.

Mr. Glaisher was elected a Fellow of the Royal Society in 1849. On the death of Lord Chief-Baron Sir F. Pollock, about 1870, he became the third President of the Photographic Society of Great Britain, an office which he still holds. This society presented to him in 1887 a marble bust of himself, executed under its direction by the sculptor Albert Toft. He was a juror in the class of scientific and philosophical instruments at the Great Exhibitions of 1851 and 1863, and was the reporter of the class in 1851.

Mr. Glaisher is the author of more than one hundred books and papers relating to astronomy, meteorology, and the theory of numbers. Some of these have already been mentioned. Among the others are many papers in the "Proceedings of the British Association" relating to his balloon ascensions and the subjects of his special investigations. His best-known work is "Travels in the Air," of which he is joint author, which is composed of the narratives by himself of his own balloon voyages and observations, and accounts by M. Gaston Tissandier and M. de Fonvielle of their experiments in the same line. He edited and compressed the English version of Camille Flammarion's "Atmosphere," performing, in addition to the regular labor of such a task, that of reducing the notations of the French system to their equivalents in English units, and replacing French observations and data with English corresponding ones. In 1877 he translated and edited Amedée Guillemin's "World of Comets." After he retired from the Royal Observatory he devoted himself to the completion of the factor tables, begun by Burckhardt in 1814 and continued by Dace in 1862–'65; Burckhardt published the first three millions, and Dace the seventh, eighth, and ninth millions. The three intervening millions have been calculated by Mr. Glaisher and published, with a full enumeration relating to the whole nine millions, in three quarto volumes. Since 1880 Mr. Glaisher has been chairman of the Executive Committee of the Palestine Exploration Fund.

CORRESPONDENCE.

GRANT ALLEN ON THE WOMAN QUESTION.

Editor Popular Science Monthly:

IT is gratifying to know that so able an advocate as Mr. Grant Allen has come forward to champion the cause of the real emancipation of woman, in claiming for her the right to be exempt from the burden of her own support. To meet with success as a bread-winner in these days of severe competition requires the best energies of the best years of life—just the time when a mother should be giving the best energies of life to the care of her children. The difference between a well-mothered child and an ill-mothered one, in morals, conduct, intelligence, and teachableness, is so great as to warrant the assertion that, next to heredity, a child's home training is the most important factor in the evolution of its character. Nature has ordained that for this training it shall look to the mother, and hence it is a self-evident fact that her own education should be such as will best fit her for the task. It is about what constitutes the proper training to this end that opinions differ. The average man thinks that to know how to make pies and sew on buttons is enough, while we "advanced" women believe that a "wise" and "sane" mother should be able to meet the moral and intellectual requirements of her children as well as administer to their physical wants. We believe that she should know enough of science to give reasonable answers to her children when they question her about the phenomena of nature, and not to object to the study of botany as improper for girls (which I heard a model mother of the good old school do, the other day) because it talks about the ovaries! We believe that her literary taste should be sufficiently cultivated for her to take pleasure in reading something above the inane fiction which constitutes the chief intellectual pabulum of the average woman of to-day; and even if she should have a taste for anything so dreadful as the higher mathematics, we see no great harm in her indulging it, if it gives her pleasure to do so; the worst that can possibly result being to give her children inherited aptitudes in the same direction. Indeed, we see no danger to the established order of the universe in her cultivating intellectual tastes simply for her own pleasure, if she chooses. It is only when a woman has to add the drudgery of bread-winning to the natural duties of her sex that she need be condemned to intellectual atrophy.

In dealing with this part of the subject, Mr. Grant Allen seems to have lost his usual clear-headedness when he mistakes the aim of "the woman's movement" for an "endeavor to put upon the shoulders of women, as a glory and a privilege, the burden of their own support." Now, I feel safe in affirming that there is not one among us, even of the most "advanced," who would not gladly welcome Mr. Allen's ideal civilization, in which all the labor should be done by men—and we won't even grudge them the cooking and the washing, which I can assure them is labor just as real as buying cotton futures or watering railroad stocks. The "woman's movement" does not aim to *force* upon women the burden of their own support, but merely to fit them, when that burden is forced upon them, to bear it successfully. Recognizing, as we do, the fact that, with our advancing civilization, a large and ever-increasing proportion of women must be self-supporting, we believe it is unjust and cruel that they should have to engage in the struggle handicapped by ignorance, hampered by conventional prejudices, and oppressed by political disabilities that deny us a vote even on the whisky question—a subject of such vital importance to us. In disposing of a large proportion of the 700,000 superfluous females of the United Kingdom as "infants, lunatics, sisters of charity, unfortunates, and ladies of eighty," Mr. Allen "explains" his statistics on one side only, and forgets to offset his incapables by at least an equal proportion of infants, lunatics, priests, octogenarians, convicts, drunkards, and other ineligibles of the opposite sex, to say nothing of that vast mass of incompetents who must rank away down below zero as husbands, and have to be supported by their wives or sisters. The existence of these negative quantities on the other side is one of the "deplorable accidents" that men are prone to overlook in considering this question, but it is one which enlarges so enormously the number of necessarily self-supporting women as to make it an open question whether they do not constitute a majority of the sex instead of a minority. Now, I am not arguing that this is right, but it is a deplorable fact all the same; and since we can not force the wicked men to support us, the bravest and strongest of us (instead of sitting down and crying about it) are claiming the modest right to at least support ourselves—and too often the men who ought to be supporting us into the bargain, or the children whose bread they are spending for whisky. And while we are thus relieving society of its "potential" paupers, can the witty philosopher think of no better return than to consign us, with a stroke of his graceful pen, to everlasting

confusion as mere paltry accidents? Oh fie, Mr. Grant Allen!

One more word, as to the supposed effect of the higher education in deterring girls from marriage. I have been engaged in dispensing the higher education to girls for a good many years, and have yet to meet the first one who was the least averse to matrimony; on the contrary, to quote from a composition on "Girls," written by a little friend of mine not long ago, "I think it is the nature of girls to have sweethearts, whether they are little or whether they are big."

The only influence that education can have in "cornering" the matrimonial market is by making girls more fastidious, and this is not likely to have any practical effect except in the case of a few ugly girls. While I do not doubt that all women are just as willing to look pretty as they are to get married, the "factors of organic evolution," which have taken the place of our old-fashioned "providence," have not improved at all upon its methods, but have dealt so unfairly with a large proportion of the sex that, when told by Mr. Grant Allen that their first business is to look pretty, they feel very much as that philosopher probably does when blandly requested by the photographer to "assume a pleasant expression."

Now, as marriage means survival of the prettiest, rather than survival of the fittest (unless we take a purely masculine view of the case and assume that the prettiest *are* the fittest), all the matrimonial plums fall into the laps of the pretty girls, and the ugly ones have no chance at all but to take everybody's leavings. Of course, I know it is very unreasonable for an ugly girl to ask for any of the plums out of life's pudding; but then, women will be unreasonable, to the end of time—that is one of the factors of the woman question with which we shall always have to reckon. Moreover, the ugly girl sometimes has the presumption to be exceedingly clever, and feels that she can do much better for herself than marry a scrubby little clerk on forty dollars a month. Under the old *régime*, when marriage was the only possible solution for a woman of the problem of life, she had no choice but to take any man she could get; but now she naturally declines to give up a hundred-dollar salary for a fifty-dollar man. I do not pretend to decide the question whether the general good does not demand that she should still be forced to sacrifice herself in a distasteful marriage, rather than remain single to swell the number of "deplorable accidents" that so weigh upon Mr. Grant Allen's mind. From a human point of view it is undoubtedly for the general good that lobsters should be boiled, but we shall hardly get the lobster to look at it in that light.

E. F. Andrews.

Wesleyan College, Macon, Ga.,
December 9, 1879.

DECADENCE OF FARMING IN ENGLAND.

Editor Popular Science Monthly:

I was very much interested in "The Decadence of Farming," which you published in November from the pen of Joel Benton. The picture which he draws of the destruction of the farming interest, both East and West, is a vivid one, and deserves the studied consideration of economists. I do not now say that the statements of facts are overdrawn, that the conclusions drawn are illogical and strained, nor that the condition of affairs, as depicted, can be logically and naturally explained in antagonism to Mr. Benton's conclusions; nor do I stop to point out, now, the facts which his article contains, which, if reasonably interpreted, will nullify his conclusions. My purpose in this letter is to present another picture, not so artistically drawn, it may be, but as true to life, I think, as Mr. Benton's picture.

The daily papers of November 30, 1878, contained a news-telegram from London, dated the 29th. After noticing the condition of trade, the closing of factories, and the reduction of wages, it continued: "Kentish hop-growers say, 'As the general depression of agriculture and commerce is largely caused by the protective tariffs of other countries, the duties on foreign productions should be revived.'"

I do not know the political views of the reporter of that dispatch; but the Associated Press reports are presumed to be non-partisan.

The New York correspondent of the Cincinnati "Enquirer," under date of December 12, 1878, sends to his paper the report of an interview with Mr. Armour, the noted dealer and packer of meats, of Chicago, who had just returned from an extended tour in Great Britain. In the reported interview Mr. Armour said: "The manufacturers are running behind, the tenants can not pay their rents, real estate has shrunk in value and can not be sold at any price. . . . The shrinkage is awful. . . . The hard times," he said, "will end in a dreadful depreciation of real estate."

I do not know the politics of Mr. Armour; the "Enquirer" represents the theory of "free trade."

The Chicago "Tribune" of July 8, 1879, reprinted from the New York "Herald" an editorial in regard to English affairs, in which the "Herald" said, "The agricultural depression in Great Britain has been felt for a long time very severely by the tenant farmers." The "Herald" then quoted from the "Pall Mall Gazette" that "the prevalent belief as to the severity of the depression existing in English agriculture will be confirmed by figures recently produced before the Devizes Union Assessment Committee."

The three papers mentioned in this paragraph represent free-trade ideas.

The London "Telegraph," of March 26, 1881, as cited by several American journals, said that, according to a correspondent of a provincial contemporary, "the depression in the agricultural districts is fully as great as it was represented by many of the speakers in the debate in the House of Commons on Wednesday. . . . Thousands of acres," it said, "are lying unproductive, because without tenants, in various parts of England; and a clergyman, writing from Nottinghamshire, gives a doleful account of affairs in that district. There seems, he says, to be a better state of things in towns than in the country. Here general bankruptcy seems imminent. Hundreds of farms are to be let and few farmers seem to have any capital left to take them." No reform of more urgent interest could possibly be taken in hand by any ministry than the raising of British agriculture from its present drooping condition.

Under date of January 10, 1881, consular clerk Charles F. Thirion, of Liverpool, reported to the State Department some facts concerning English agriculture. The comparisons, when not stated otherwise, are between 1870 and 1879. The report shows a decrease of arable area, 3·3 per cent; of corn land, 3·1 per cent; of wheat land, 16·3 per cent; of barley land, 13·8 per cent; of oat land, 4·4 per cent; a comparison of 1879 with 1874 shows a decrease in the number of sheep of 1,414,000, a little more than 7 per cent.

The Chicago "Tribune" of June 21, 1881, reprinted from the New York "Tribune" an article upon English estates. In that article the "Saturday Review" is quoted as saying, "A state of things has undoubtedly existed for some time, and still exists, which justly awakens great anxiety for the future of the country, and profound sympathy for the sufferers. . . . The advertisements in the London 'Times' bear eloquent testimony to this state of things. Columns are filled with notices of old country residences, broad demesnes, wooded parks, and snug country-houses to be sold. . . . Ninety-five per cent of the small estates are mortgaged, often for one third or two thirds of their value."

The New York "Tribune" represents protective ideas the other two papers are free-traders.

A telegram from Washington to the St. Louis "Globe-Democrat," dated August 7, 1882, stated that a communication had been received at the State Department from the consul at Liége. As reported by the telegram, that communication contained this summary: "In one year, the falling off in English agriculture was 42 per cent; for six consecutive years it was 20 per cent."

The "Globe-Democrat" is recognized as a protective organ of a very conservative type.

The Chicago "Inter-Ocean" (protection) of September 27, 1889, reprints this excerpt from the London "World": "An example of the ruinous depreciation of agricultural land in Lincolnshire was recently afforded when a farm with houses and buildings, in the neighborhood of Alford, was offered for sale, and the highest bid was £2,100, although the property cost £6,700 eighteen years ago, and a considerable sum has since been expended in improvements." The same Chicago journal quotes from the London "Times" that "fifty per cent of the dock laborers, including perhaps the permanent men, are agricultural laborers in point of origin."

The startling likeness of the two pictures must be remarked. The one is fuller, decked off with more rhetoric, than the other, but the essential features are the same: the heavy mortgages; the depreciation in value to one third of the cost; laborers abandoning the farms for town and city; the abandoned (at least uncultivated) lands; unprofitable farming; decrease in productions and of sheep. I have given the character of my witnesses, when known. If Mr. Benton had admitted that his principal witness on the wool question, Hon. John E. Russell, was a free-trader and interested in free wool (which I understand to be facts), the value of his "opinion" would be heavily discounted. The pertinent question that must arise here is, If the protective tariff of the United States has destroyed the agricultural interests of this nation, did the free-trade policy of Great Britain cause the great depression in the agriculture of that nation? In other words, does agriculture prosper any more under free trade than under protection? M. B. C. TRUE.

EDGAR, NEB., *December* 7, 1889.

THE TEST OF INSANITY.

Editor Popular Science Monthly:

SOME parts of the paper by Dr. Sir James Crichton-Browne, in the November number of your journal, are open to serious criticism. I refer especially to his remarks "on the insufficiency of the definition or test of insanity laid down by British and American courts, and on an amended test which would commend itself to medical experience."

It is admitted by the learned writer that the accepted legal test—a knowledge of right and wrong in reference to the criminal act—is satisfactory in most cases; but he holds that there are certain morbid states of the emotions and will which constitute insanity, although connected with a sound intellect. Now, the vast majority of medical men with experience of the insane have no knowledge of such cases. For myself, I have never seen a case of this kind in the examination of several thousand lunatics, and I have never heard of any mark by which these can be distinguished from cases of vice and crime. Dr. Crichton-Browne

commends the test of Lord Bramwell, contained in the questions: "Could he help it? Was the lunatic free to choose, or under the duress of disease?" And there is no doubt that the power of self-control is an essential element in the question of responsibility. We may even admit that "impairment of will or loss of self-control, more or less pronounced, is the first, last, and universal element in insanity." But impairment of will is found in all human beings, the sane and the insane. A heathen poet has confessed: "*Video meliora proboque, deteriora sequor.*" [I perceive the better things, and approve them; I follow the worse.] And a sacred writer declares: "The good that I would, I do not; but the evil which I would not, that I do." Loss of self-control, then, is not at all peculiar to insanity, and the degree of this loss has no measure in medical science. Plainly, the proposed test is quite without value, and, indeed, is no test at all.

Again, it is proposed to make "a condition of insanity" the test of responsibility. But the term insanity is so extremely vague and indefinite, even as used by medical men and experts, that it is worthless for such a purpose. It is applied to every kind and degree of chronic mental disorder, without reference to the element of responsibility. About fifty years ago a law was enacted by the Legislature of New York in these words: "No act done by a person in a state of insanity can be punished as an offense." But Chief-Judge Beardsley (in the Freeman case, 4 Denio, p. 27) held that the natural construction of this act "would indeed be a mighty change in the law, and afford absolute impunity to every person in an insane state." He refused, therefore, so to construe it, and held to the principle of the English law, which has ever since been adhered to by our courts.

It is plain, indeed, that insanity may exist in a degree calling for medical treatment, and even for confinement in an asylum, without bringing with it irresponsibility for crime. In the case of Speirs, a patient set fire to the Utica Asylum to revenge a wrong done him by the authorities. The act was found to be a sane one, and the lunatic was sentenced to a long term in the State prison. It is safe to say that in most asylums there will be found at least ten per cent whose degree of insanity is less than that of the notorious Guiteau. But the jury were able, under the common-law test, to find that Guiteau's motive was a vicious one, and that he had the power to refrain from his crime.

So indefinite, however, is the line between sanity and insanity, and so hard to be drawn in cases made still more difficult by passion and prejudice, that the plan of a permanent commission, of lawyers and physicians, to visit those who have escaped punishment on the ground of insanity, and report, from time to time, on their condition, should be commended to our Legislature. In this way, perhaps, some light may be thrown on the question of a legal test of insanity, and upon the true value of expert evidence. At present, in view of the law which forbids a physician to disclose on the witness-stand any information acquired by him in a professional capacity, thus often withholding facts of the utmost importance, the necessity of expert testimony in lunacy cases must be admitted. It remains, however, to define more exactly who are experts, by whom they shall be called, and what questions they shall answer. Upon these points, also, the suggestions of Dr. Crichton-Browne are most practical and valuable.

L. A. Tourtellot, M. D.

Utica, N. Y., *November* 30, 1889.

EDITOR'S TABLE.

USEFUL IGNORANCE.

MR. HERBERT SPENCER, in a well-known essay, has discussed the question, "What knowledge is of most worth?" It is perhaps time to begin the discussion of the question, "What ignorance is of most value?" There is a story told of the great philosopher whom we have just named that, on one occasion, in reply to a question upon some rather minute point of history or archæology, he expressed a devout thankfulness that he knew nothing whatever about it. The capacity of even the greatest minds is limited; and the man who would make the best use of his powers of memory must exercise a wise discretion as to the things he undertakes or tries to remember.

If any principle in education ought to be clear, it is that there should be no overcrowding in the mind of the pupil, but that each portion of knowledge imparted should have room to define itself, to assume distinctness and to grow. Where there is overcrowding there will be no sense of order and no

healthy development of ideas. All educators acknowledge this, just as men in general acknowledge the moral law; but how many of them live up to it? How many of them are willing to leave in their pupils' minds liberal tracts of ignorance, acknowledged as such—tracts which might be cultivated, but which are left fallow simply in order that the mental powers may not be overtaxed nor imagination unduly restrained? We venture to say that the cases are rare in which an effort is not being made to cultivate, as it were, every square inch of mental territory, and call all the strength of the intellect into exercise. Each school or academy must teach so many "branches"; it would never do for one to omit what another has in its curriculum; and every pupil, if not compelled, is urged to take up just as many subjects as he or she can possibly grapple with. The general, at least the frequent, consequence is — congestion, confusion, enfeebled memory, impaired judgment, lowered intellectual vitality. Better far, in many cases, would it have been if the child, with no education beyond reading and writing, had lived in a concrete world and picked up, gradually, verifiable notions about real things. There is nothing fortuitous in the fact that so many men, eminent in various departments of life, have had but the most meager "educational advantages" in their youth. It would seem as if the one great "educational advantage" they had was in getting free from so-called education at a very early period and betaking themselves to the school of active life—a school that leads up to abstract truths only through multiplied concrete examples; that leaves ample space in the mind for useful ignorance, and consequently makes all the better provision for useful knowledge.

There is much sound philosophy in regard to education abroad in the world to-day. What is needed is, that educators should be as wise in practice as they are in theory. The labor of the gardener, every one knows, consists, to a large extent, in "thinning out" his crops. If a similar process could be practiced on the minds of the young, and if it were practiced, the evils of too copious sowing would not be so great; but, as the method is hardly applicable to intellectual growths, teachers should educate themselves up to the point of sowing sparingly in order that they may reap abundantly. The evil of too thick sowing attains, we believe, greater proportions in academies for young ladies than anywhere else. There, nearly everything that is taught to boys enters into the course of instruction, while music and other "accomplishments," together with an extra language or two, are generally superadded. As if this were not enough, a special acquaintance with the literature, history, and institutions of the ancient Jews, untinged, however, by any touch of "modern criticism," is frequently also insisted on. The effect of all this may be easily imagined—a spindly growth of rootless ideas, habits of intellectual indifference, a medley of incongruous notions in regard to ill-apprehended facts; in a word, a seriously injured, if not a fatally ruined, intelligence.

The intellectual signs of the times, it should be remembered, are not all favorable. We have such an educational apparatus, for extent and scope at least, as the world never saw before; but the results—it is not easy to be enthusiastic over the results. Where is the quickened sense for evidence that we might have expected to see? Where the seriousness of intellectual aim? Where the refinement of popular taste? Cant seems to stalk abroad through the world as potent an enslaver as ever of the minds of men. Credulity is wide-spread. Superstition still occupies its strongholds and rules over vast multitudes. Faction controls our politics and legislation is made a plaything. We have, perhaps, expected too much of education in the past; but at least, if we un-

derstand its true principles, we should try to apply them. One of the first of these principles is not to teach too much, not to congest the mind, not to overtax its powers. Our effort should be to whet curiosity, awaken a certain variety of interests, develop the natural powers of the mind, and leave room for the imagination to work. It is the spontaneous effort of the mind, not its forced labor, that yields the best results. Hitherto we have been fighting ignorance so hard, and have been so afraid of it, that the idea of knowledge in any degree being dangerous has seldom occurred to us. But knowledge may be as dangerous as food, if given in wrong quantities and under wrong conditions. When we realize this as fully as we have heretofore realized the danger of ignorance, a new era in education will have dawned.

INDIVIDUALISM.

THE discussion on the land question in the London "Times," a further installment of which is given in our present issue, will have, we may hope, one or two good results. It will tend to produce in the public mind a more vivid sense of the difficulty of dealing with the land question on any abstract principles, and it will help, perhaps, to bring home the lesson that social progress is more a matter of individual improvement than of political reconstruction. Mr. Auberon Herbert, in the letter which we print this month, calls attention to the fact that the whole drift of Mr. Spencer's philosophy is toward individualism, and suggests that the social dangers of the present time arise precisely from the fatal disposition of men to invoke state action as a remedy for all evils. It is indeed a serious fact that so few of those who seek to catch the public ear lay any emphasis on the need for individual reform, or have anything to say about individual responsibility. Institutions are wrong, laws are wrong, social organization is wrong—all general forces and agencies are wrong; but rarely does any one discover that this or that man is wrong. Such a discovery, if made, would perhaps not be thought worth announcing, or perhaps might not be considered safe to announce. It is more popular to abuse institutions at large than to attempt to fix the responsibility for their defects; and no prudent orator would think of suggesting to his audience that the true starting-point of reform would be in the habits and dispositions of just such people as themselves.

Mr. Frederick Greenwood's letter, published by us last month, furnishes a striking illustration of the readiness with which the principle of personal responsibility is overlooked by even thoughtful writers. Mr. Greenwood reads a lesson to Mr. Spencer for having, as he considers, put forward certain radical theories as to land tenure without sufficient qualification, and so given occasion to men like Mr. Laidler to quote him in support of their revolutionary schemes. The true view of the matter, however, is that Mr. Spencer acquitted himself of his duty to society by giving expression to the opinions which, at the time, commended themselves to his acceptance. He did not force them upon the world, or upon any one. He did not offer them as infallibly inspired; he gave them simply as the views of Herbert Spencer, guaranteeing nothing, even by implication, save their sincerity. What was the nature, then, of his responsibility in the matter? We answer that he staked, to a certain extent, such literary or philosophical reputation as he had, at the time, acquired, and made himself a mark for the criticism of all who differed from him in opinion. On the other hand, he did *not* render himself responsible for all who might adopt his views simply because they were his, or for those who, under any circumstances, accepted them without sufficient examination, possibly with-

out possessing the qualifications necessary for giving them any examination deserving of the name. Nor did he make himself responsible for the inertness of those who, having examined the views in question and found them unsound, failed to demonstrate the fact to Mr. Spencer himself or to the public. When thirty valuable years, in which certain (let us assume) erroneous speculations might have been combated, have been allowed to slip by unimproved, so far as that object is concerned, it seems late in the day to turn round on the author of the speculations and read him a lesson on the responsibilities of a philosopher. The true way in which to have enforced his responsibility was to criticise his views with the utmost rigor, misrepresenting nothing, but omitting no argument that may fairly tell against them. It should not be forgotten, however, that Mr. Spencer showed a further sense of responsibility in withdrawing from circulation the book in which his speculations on the land question were contained, as soon as he became convinced that the views enunciated by him upon that point and upon one or two others discussed in the same volume needed amendment or qualification, and in giving it to be distinctly understood that he no longer held to his former opinions on these matters. It is hard to understand, therefore, how the principle of personal responsibility could have been more fully recognized, or the duties flowing therefrom more scrupulously performed, than they were in this particular case by the eminent author of the "Synthetic Philosophy."

More to the purpose would it have been, in our opinion, had Mr. Greenwood dwelt with some force on the responsibility—too little recognized—which rests upon those who pin their faith to the authority of others. This is a thing which is too often done in a most reckless and irresponsible manner, with the result of rendering public opinion far less intelligent than it ought to be and might be. A sense of individual responsibility for opinions accepted would lead to a more careful examination of all theories and reasonings; and would, in a multitude of cases, abate the blind confidence with which ill-understood notions are now espoused. It is quite true that every one is not able to subject the views of a writer like Mr. Spencer to critical scrutiny; but those who can not do it should, at least, try to take the right measure of their own powers, and abstain from judgments for which they can not give adequate reasons. Very serious also is the responsibility resting upon those who recognize that an opinion which has been given to the world is erroneous. The duty of such persons is to proclaim what they hold to be the truth according to the measure of their opportunities and the urgency of the occasion. Because A has accidentally kindled a conflagration, shall B, who is passing by, and who has water at command, make no effort to arrest the flames? Upon whom, in such a case, does the heavier blame rest—upon the man who, without intending it, has set things on fire, or the man who, rather than take a little trouble, lets the fire gain headway? The doctrine of individual responsibility is the true leaven that will leaven society; for it comes home to each man and summons him to put the question seriously to himself whether he is making the most and the best of his own powers, whether he is really striving to be an efficient unit in the social body. Thousands, nay millions, to-day are waiting for some supernatural or revolutionary moving of the waters, in order that they may, in a moment, be healed of their infirmities. The doctrine of individualism bids them halt no longer by the pool, but go straightway about their business in a new spirit of duty and self-help.

We are glad to welcome the appearance of a book which promises to help in this direction, namely, Mr. Wordsworth Donisthorpe's "Individualism, a

System of Politics"—a book which ably vindicates the sufficiency of individual initiative in a vast number of matters that have been laid hold of by the state. The present mania for legislation Mr. Donisthorpe attributes to the inexperience and want of historical knowledge of the classes who now control the suffrage. Errors which the more thoughtful and instructed members of the community have outgrown still look like truths to the less thoughtful and less instructed. The watchword of the hour is individualism, which simply means personal liberty and personal efficiency carried to their highest point. Let all who believe in this do their utmost to make the truth prevail.

LITERARY NOTICES.

CHRISTIAN THEISM: ITS CLAIMS AND SANCTIONS. By D. B. PURINTON, LL. D. New York and London: G. P. Putnam's Sons. Pp. 303. Price, $1.75.

THE author of this book, who is Professor of Metaphysics in West Virginia University, in presenting his thesis, has had three objects in view, viz.—to construct a progressive argument logical in its method and correct in its general conclusions, and likewise defensible in each individual part and item of it; to free the subject from ordinary obscurities and difficulties; and to present it, "without dodging any of its profound problems," in such a clear and simple manner as to commend it to the general reader who is willing to think as he reads. Christian theism being presented as a fact, making positive, bold, radical, uncompromising, and universal claims, the author presents as arguments in support of it: Intelligence in nature, the eutaxiological argument; volition in nature, the teleological argument; the personality of God, or the intuitive argument; the goodness of God, or the historical argument; the unity of God, or the monistic argument; and the infinity of God, or the causal argument. As "antitheistic errors" are combated materialism, pantheism, positivism, and agnosticism. The last system is regarded as "an ingenious combination and modification" of the other three systems, which in its present phase has taken shape and name from Herbert Spencer, "the great agnostic of modern times," a study of whose works "produces a profound conviction of his depth and patience of thought, his breadth and profundity of scholarship, his fertility of imagination, and his frankness and earnestness of purpose." This system is reviewed in an attempt to show it to be logically self-destructive. A comparison of "Evolution and Christian Theism" leads to the conclusion that most of the objections to the former scheme lie not so much against evolution as against the mechanical form of it. "Nature is not a machine, for it is plastic, progressive, improvable, while a machine is neither of these. Matter can reveal higher and still higher forms of organism, but can never create them. Matter, motion, and force, without a directive idea, can do nothing toward explaining a rationally developed universe. But why exclude a creative and directive idea? Let that idea be God. There is not a single fact in nature against the existence of a personal God or the occurrence of an act of creation. There are many facts in favor of both. Why not admit that God made the world and sustains it in being? That admission would not blot out evolution, but would view it as a possible or it may be probable method of God's creative and providential work." The question would then be not "evolution *versus* creation," but "evolution the method of creation." The question of immortality is also considered.

THE LAND AND THE COMMUNITY. By S. W. THACKERAY. New York: D. Appleton & Co. Pp. 223. Price, $1.

THIS work bears the indorsement of Henry George, who supplies it with a preface. In its original form it was presented as a thesis to the University of Cambridge for the degree of Doctor of Laws. The essay has been expanded and arranged for reference. It is commended for the fullness and clearness with which the historical and legal aspects of the question have been dwelt upon, the attention given in it to the matter of compensation, and the religious feeling and conservative disposition manifested in it throughout. It serves the office, according to Mr. George, of a clear and sim-

ple exposition of essential principles and important facts, which shall give force and definiteness to the ideas growing out of the doctrine of equality of right to the use of the land, make manifest their conformity with historical experience and religious truth, put them in such a relation that the recognition of common rights in land may strengthen, not weaken, the recognition of individual rights in the products of labor; and supply answers to the arguments urged upon the other side. Mr. Thackeray begins his thesis with a history of land tenure in England, divided into the pre-feudal, feudal, and post-feudal periods, in which the subject is treated with special reference to the rights and interests of the community as distinct from the individual interests involved. The origin of the present system is traced to the acts of 1656 and 1660, "which turned military tenures into free and common socage." Community rights were trampled upon or ignored under these acts, the custom of making settlements grew up and was recognized, and lands before common were inclosed without effective resistance till about half a century ago, when laws were passed restricting the right. The key to the future of land tenure may be found in the exercise of the right of eminent domain, which the author regards as an assertion of the state's ownership and its right to change tenants on condition of the new tenant indemnifying the old one for the damage he may suffer. The right of the community to resume its possession of the land being, as the author believes, shown, a second part of the work is occupied with the questions relating to compensation. The rights of the community may be reasserted and secured by requiring those who occupy or cultivate the land to pay to the community a full equivalent for the special privileges which they thus enjoy —that is, through the appropriation of ground-rents by taxation, and applying the proceeds for the benefit of the whole community. A plan is outlined for effecting the change with the least harshness; and the beneficial effects anticipated from it are enumerated. As to those who may be supposed to be injured by the change—reduced to landlords—the conclusion is reached that most landlords would lose nothing without receiving advantages nearly if not fully compensating them; while the others, if not relatively as great gainers as other classes of the community, would not be absolute losers. The landlords' claims for compensation are examined and found not good, either in law or equity—in fact, the claim of the community against them is assumed to be the better one; and, finally, they are invited manfully to accept the situation, and themselves lead in recognizing the justice of the new dispensation.

STUDIES IN PEDAGOGY. By THOMAS J. MORGAN. Boston: Silver, Burdett & Co. Pp. 355. Price, $1.75.

THE author, Principal of the Rhode Island State Normal School, and before that of normal schools at Potsdam, N. Y., and Peru, Neb., has embodied in this volume the fruits of many years of observation, reading, thinking, and experience in the exercise of his profession, and makes in offering them "an earnest effort to contribute toward the promotion of higher ideals of education and better methods of teaching." His view of education in the general sense is a broad one, and embraces all that marks the difference between what a child is by nature at birth and that which he becomes by growth, training, and experience. In this sense, nature is embraced as one of the greatest forces of education. In the narrower sense, to the consideration of which this book is chiefly devoted, education is restricted to the effect produced upon the young mind by those who seek purposely to influence it, or the direct influence of teachers and schools. Its most important factor is training, which here signifies such a control exercised by the teacher over the pupil as will lead him so to use his faculties as to secure their completest development; and which has for its immediate end the evolution of power. These faculties may be grouped under the heads of acquiring, understanding, reproducing, using, and expressing knowledge, each of which, again, includes its own several topics and means. More nearly than any other work of the teacher it meets the ideal of education; it is an essential preliminary to a successful work of instruction; and is the process that best prepares the student for the active duties of life. The special applications of training discussed are those to the

senses, the imagination, thinking, the sensibilities, language, the will, learning music, the use of books, and "training for freedom." There must be method in the performance of the teacher's work; hence we have a series of chapters on "Methodology." In "Man and his Method" the principle is enforced that, important as the method may be, the man behind it, who should inspire it, is more so. Method in questioning and in teaching arithmetic is treated with some fullness. The value and purpose of examinations are estimated. "The Ideal Schoolmaster" holds up the objective toward which every teacher should strive. "The True Function of a Normal School" is a paper which was awarded the prize of the American Institute of Instruction in 1885. "Advice to Young Teachers" embodies the substance of several addresses to graduating classes of the normal school. In them "Independent Thinking" and "Training for Citizenship" are prominent topics.

GEOLOGY OF THE QUICKSILVER DEPOSITS OF THE PACIFIC SLOPE, WITH AN ATLAS. By GEORGE F. BECKER. Washington: Government Printing-Office (United States Geological Survey). Pp. 486, with seven Plates. Atlas, 14 sheets. Price, $2.

THE field work of the investigations recorded in this volume occupied the most of three seasons, beginning in 1883. There remained to complete the examinations satisfactorily the investigation of some important general problems affecting the whole region. Among these were indications afforded by the paleontology and structure of a previously undetermined non-conformity existing in the Coast Ranges. These were confirmed. Another investigation related to a possible connection between the formation of ore deposits and the metamorphism of the Mesozoic rocks. A third special inquiry was directed to determining whether the deposition of cinnabar is still taking place at Sulphur Bank and Steamboat Springs, and, if so, under what conditions the solution and precipitation of cinnabar and the accompanying mineral occur. The author finds that the quicksilver deposits lie along the great axes of disturbance of the world. One of these is on the line of the principal mountain systems of Europe and Asia, and the other coincides with the western ranges of the Cordilleran system of America. The principal mines are at Almaden in Spain, Idria in Austria, Huancavelica in Peru, and those in California. From 1850 to 1886 California supplied nearly half the product of the world, but is not probably destined to maintain the same rank in the future. Quicksilver was first recognized as occurring at the croppings of the new Almaden mine in 1845. But few other minerals occur in considerable quantities with the ore. Among them are pyrite or marcasite, arsenic and antimony, and sometimes copper ores, while other metalliferous minerals are comparatively rare. The principal gangue seems to be silica or carbonates. The cinnabar appears to have been deposited solely in pre-existing openings, and never by substitution for rock. The fissure systems, which are always present, are very irregular, and deposits can not conveniently be classified according to existing systems. All of them seem to have probably been deposited in the same way from hot sulphur springs. At Sulphur Bank cinnabar is now being precipitated from heated waters largely by the action of ammonia; at Steamboat Springs it is being deposited without complications from the presence of ammonia. In dealing with the processes by which the ore has been dissolved and precipitated in nature, it has been shown by experiment and analysis that cinnabar unites with sodium sulphide in various proportions, forming soluble double sulphides, and that these compounds can exist in such waters as flow from Sulphur Bank and Steamboat Springs, either at ordinary temperatures or above the boiling-point. The quicksilver is probably derived from granitic rocks by the action of heated sulphur waters, which rise through the granite from the foci of volcanic activity below that rock.

COAL AND THE COAL MINES. By HOMER GREENE. Boston and New York: Houghton, Mifflin & Co. Pp. 246. Price, 75 cents.

THIS is a volume of the attractive "Riverside Library for Young People," and is intended to tell readers, in a style free from minute details and technicalities, all that relates to coal and to procuring it from the earth. The information has been gained for the most part, the author says, from per-

sonal experience in the mines; but little of it comes from books, for the literature of the special subject is meager. Beginning at the beginning, we have a brief reference to the geological record previous to coal. Then the composition of coal is elucidated, the time when it was formed is defined, and the situation of the coal-beds is described. The history as it relates to our own period begins with the discovery of coal and its introduction into use. The account of the mines includes the way into them, the plan of a typical mine, "the miner at work," the obstacles and dangers he has to encounter, and the anthracite breakers. A chapter is given to the bituminous coal mines. The account of "The Boy Workers at the Mines" is of particular interest to the young people, and the chapter on "Miners and their Wages" to searchers for facts.

A HANDBOOK OF OBSTETRICAL NURSING. By ANNA M. FULLERTON, M. D. Philadelphia: P. Blakiston, Son & Co. Pp. 214. Price, $1.25.

THE great number and variety of the things to be attended to in a case of childbirth, many of which are not so familiar as the matters concerned in the treatment of disease, together with their importance as affecting two lives, make a special manual on this subject highly desirable for the nurse. It would be well, also, for every mother to have read a book of this sort before her confinement, in order that she may understand and co-operate in the efforts of the physician and nurse for her welfare, and be protected from the antiquated wisdom and dismal tales of injudicious friends. It would be difficult to make a more comprehensive and practical book than Dr. Fullerton's. It is an outgrowth of the extensive practice of the hospital and the systematic instruction of the nurses' training-school. The teachings which it embodies are chiefly the substance of a series of lectures delivered yearly by Dr. Anna E. Broomall to the nurse-pupils of the Woman's Hospital of Philadelphia, and they are followed in the Maternity connected with that hospital. The whole ground from the management of pregnancy to the ailments of early infancy is covered. Directions, sufficiently detailed for the use of a trained nurse, are given for the care of the patient immediately before and during labor, for the care of the new-born infant, and the management of the lying-in. The appliances which the nurse will need to use, and the articles of clothing for mother and child, are described, and many of them are figured. The Jenness-Miller reformed garments are indorsed. A short chapter is devoted to the appearance of infants in health and disease. In the chapter on ailments of infancy the *couveuse*, or brooder, for keeping premature infants warm, is described and figured. Throughout the volume reference is made easy by printing the subject of each paragraph in the margin.

FOSSIL FISHES AND FOSSIL PLANTS OF THE TRIASSIC ROCKS OF NEW JERSEY AND THE CONNECTICUT VALLEY. By JOHN S. NEWBERRY. Washington: Government Printing-Office (United States Geological Survey). Pp. 152, with 26 Plates. Price, $1.

THE Triassic rocks, according to Prof. Newberry, probably furnished the first fossils collected on this continent: fishes at Durham and Sunderland, Conn.; plants at Richmond, Va.; and the so-called bird-tracks at Turner's Falls, Mass. While the formation has received considerable attention in detail, no systematic collection or thorough study of its fauna or flora as a whole was attempted till about 1880, when Prof. Fontaine took it up for the fossil plants of the Virginia and North Carolina Mesozoic coal basins. His publication established the parallelism of our new red sandstone with the keuper of Europe. The animal remains were left to be studied, and that work was taken up by Prof. Newberry, with results that are presented in this volume. The special studies are preceded by a geological sketch of the new red sandstone regions of New Jersey and Connecticut, concerning the relations of which to one another there appear to be different opinions. The Triassic rocks are about five thousand feet thick and present some singularities of structure. The materials were probably derived from the adjacent highlands. The rocks are characterized by their red color, derived from the oxide of iron, the presence of which proves that they contained but little organic matter when deposited. Their relations to the Triassic beds of the interior and the western

margin of the continent can hardly be established without larger collections of fossils from Western localities. The fishes, though so far as yet known representing only six genera and about twenty-five species, are locally very numerous, and are found in many places. The principal sites represented in the volume are Boonton, N. J.; Durham, Conn.; and Turner's Falls, Mass.; while they have also been obtained at Plainfield, Milford, Newark, and near Hoboken, N. J., and at Middletown, Sudbury, Chicopee, Amherst, and Hadley's Falls, in the Connecticut Valley. The several species are described in detail and illustrated by figures apparently of the size of nature. We are glad to learn that the author's collection, which is the largest yet made, is safely deposited in the fire-proof Geological Museum of Columbia College.

LIGEROS APUNTES SOBRE EL CLIMA DE LA REPÚBLICA ARGENTINA. (Notes on the Climate of the Argentine Republic.) By GUALTERIO G. DAVIS, Director of the Argentine Meteorological Office, Buenos Ayres. Pp. 254, with 27 Plates and Charts.

THE Argentine Meteorological Office was established in 1872, and was organized under the direction of Dr. B. A. Gould, whom Mr. Davis succeeded on his retirement after twelve years of service. It has gradually extended its sphere of operations to the most remote parts of the country, and now receives observations of the more important weather phenomena from sixty-six stations, and of rainfall from ninety more. The six volumes of the publications of the office embody the results of observations taken at twenty-six points, with analytical discussions of the data, and deductions of the general laws of atmospheric changes; and the annual reports contain a large part of the results reached in the corresponding years. But a more compact work was needed to embody a summary of these results adapted to practical use; and the attempt is made to supply this need in the present volume, which is intended to put within reach of the colonist, the farmer, and the doctor such meteorological facts as bear upon their industrial enterprises and hygienic studies. Twenty-one stations are selected as typical of the various climatological conditions that prevail in all parts of the republic. The lines extend from the Atlantic coast to the western points of the country, and from latitude 54° 53′ in Tierra del Fuego to Salta in latitude 26° 46′ 20″; the altitudes range from 8 metres to 2,845 metres above the level of the sea. To each of these stations is allotted its given space for general description, with tables representing the various meteorological facts in detail and a graphic chart. The publication thus furnishes a summary of the local climates, deduced from several years' observations of the various districts of which the particular stations are the centers.

MONOPOLIES AND THE PEOPLE. By CHARLES W. BAKER, C. E. New York: G. P. Putnam's Sons. Pp. 263. Price, $1.25.

THERE is abundant reason for including monopoly among the "Questions of the Day," as is done in this volume. Trusts and monopolies exist, as the author shows at length in a series of chapters, in manufacturing, mining, transportation, trade, and labor. There are monopolies constructed directly by those who profit from them, monopolies created by municipal enactments, and monopolies supported by governmental policy. The author next examines the theory of universal competition, after which he states the laws of modern competition. He denies that "the prevalence of monopolies evidences the decay of the nobler aspirations of humanity." He regards them as an outgrowth of the modern conditions of industry, and, while they involve evils, he affirms that "the remedy for the evils of monopoly is not abolition, but control." He then specifies some of these evils, and names also some ameliorating influences. The remedies that have been proposed are based on one or the other of the opposite principles, individualism and societism, or communism. Mr. Baker maintains that neither should be adopted wholly, and in his concluding chapter advocates the owning of all railroads by the Government, and their operation by corporations which should pay a rental for the privilege; the owning of mines by the States, which should lease them to private parties for operation. Water-works, gas and electric lighting plants, street railways, and similar local enterprises should be owned by the cities in which they are located, and also

operated by private companies. Mr. Baker does not favor the same procedure in the case of monopolies in trade and manufacturing. But he would legalize them, and then force them to let daylight in upon their operations and agreements, and apply to them the principle of non-discrimination.

Aryan Sun-Myths the Origin of Religions (Nims & Knight) is the title of a book designed to show that the mythology of this great primitive race is the parent of the chief modern religions, just as the race itself is the parent of the peoples who hold these religions. In the Aryan mythology we have the immaculate conception, from which the son of heaven, the sun, is born, at the time of the December solstice. We have the twelve signs of the zodiac as his disciples; his temptation, persecution, and execution. There is a descent of the sun into hades, when he enters the sign Capricornus and appears to remain three days at his lowest point. The Aryans observed baptism, sacrifice, and the eucharist, and the doctrines of original sin and the fallen condition of man were not unknown to them. When we come down to the Hindus, who have written religious records, we find the same features and more. So also among the Persians, the Egyptians, the Chinese, the Greeks, the Scandinavians, and the ancient Mexicans. Some of the same ideas are found among other ancient nations of the Old World, and among the American Indians. "Ancestral and other systems of worship," says Mr. Charles Morris, in the introduction which he contributes to the volume, "have influenced religious practice and ceremony to a marked extent, but have had much less to do with the growth of dogma than the intricate details of the history of the gods, to which the numerous phenomena of nature gave rise. Over religious belief the sun has exercised a dominant influence, and still faintly yet distinguishably shines through the most opaquely obscure of modern theological dogmas."

In a paper on *Teaching School Children to Think* (D. Appleton & Co.), Prof. *George B. Newcomb* discusses first the question, "What is the capacity and exercise of the mind which is indicated by the terms 'thought' and 'thinking'?" He shows that in the reaction from the old mechanical drill we should avoid going to the opposite extreme of taxing the child's mind beyond its powers. The faculty of thinking is a growth, and needs to be dealt with according to the stage of development it has reached. Capacity to form abstract ideas and reason consecutively does not come at once; "yet long before reasoning, strictly so called, is developed, there is rationality, the exercise of intelligence in unifying the scattered particulars of sense; in correlating facts and lighting up one fact by another"; and it is all alive in the child's mind, in the curiosity that asks the reason why. While children dislike remote abstractions, they are capable of general thought and rational connecting, and make crude attempts at rational synthesis. The manifestations of these faculties may be watched for and taken advantage of and directed as they appear, and the child thus be led gradually up to the habit of rational thought on every subject. This precept partly furnishes the answer to the author's second question, "In what sense or within what limits, if any, should the development of thought be a prominent aim in the training of school children?" A third question, involving the consideration of ways and means for developing rational intelligence in the pupil, is too large for treatment in a single paper; and upon it the author aims only to enunciate broad principles or make helpful suggestions without going into details.

In *A Rambler's Lease*, Mr. *Bradford Torrey*, one of the most pleasant of our rural essayists, assumes the position of a leasehold tenant of other people's fields and woods to the extent of the æsthetic enjoyment and opportunities for the study of life and nature that they afford. He therefore makes himself at home in them, and keeps company with the trees and flowers and insects and birds; with some of which he has enjoyed privileges of rarely close association. The present volume contains some of the fruits which he has gathered in these possessions; seemly and agreeable fruits in every way, and flavored with occasional choice grains of wit. In it he introduces us to the wild birds which he has become so intimate with as to feed them by

hand; reports his observations on climatology and seasonal phenomena; draws the lessons to be learned from a ramble in "an old road"; exalts the man "behind the eye" rather than the eye as the important factor in observation, and the mental attitude in "taking a walk"; and presents studies of mountain scenes, "butterfly psychology," and the means by which the partridge executes his "drumming." (Houghton, Mifflin & Co., $1.25.)

The Anatomy of Astrangia Danæ, published in quarto form by the Smithsonian Institution, comprises six lithographs from drawings made by *A. Sonrel*, under the direction of Prof. Agassiz in 1849, illustrating the structure of that madrepore, the only representative of the family in shallow New England waters, with text explaining the plates by *J. Walter Fewkes*. Although there has been a great advance in histological methods since the figures were drawn, it has hardly extended to the minute anatomy of these creatures; so that the representations are nearly as fresh as if they had been drawn to-day. Whatever may be lacking to bring them up to the present state of knowledge is supplied in Mr. Fewkes's descriptions, which are based on studies of living specimens.

Studies of the Macrochires, Morphological and otherwise, with the View of indicating their Relationships and defining their Several Positions in the System, by *R. W. Shufeldt, M. D.*, bear upon the comparative anatomy and place of the swifts, whip-poor-wills, and humming-birds. The author had already proposed a separate order for the *Trochili*, or humming-birds, and is more than ever convinced of the correctness of his scheme. In the present essay he proposes a new group or order—that of *Cypseli*—for the swifts. This order, were it represented by a circle, would be found just outside the passerine circle, "but tangent to a point in its periphery opposite the swallows.

In a monograph on *The World's Supply of Fuel*, Prof. *W J McGee* describes rock gas and its occurrence; accounts for its formation by the decomposition of the organic matter contained in sediments; answers in the affirmative the question whether it is still forming, and adds that it will probably continue to form indefinitely, though at a decreasing rate; and predicts that it is destined to be, after the coal has been exhausted, the world's unfailing supply of fuel and light.

The address of Prof. *Charles A. White*, as Vice-President of the Geological Section of the American Association, is devoted to the survey and definition of *The North American Mesozoic*, particularly of the formation called Triassic. There are doubts about the correspondence of this with European formations; and this and certain other facts give occasion for the expression, with some fullness, of the opinion that we must not expect to discover a precise correspondence, either in time or character, in the geological history of our own and other continents, or an exact identity of formations in them. Hence, with all respect to European classification and names, which may still be used tentatively in each of the great divisions of the earth, and with reference to the ultimate establishment of a universal system, it is for North American geologists to elaborate a scheme for the formations of our own continent.

In a pair of papers on *Meteorites and what they teach us*, Dr. *H. Hensoldt* summarizes what has been learned about meteorites, and declares his own theory as to their origin. This theory is based on the presence of liquid carbonic acid in the cavities of these bodies. The fluid is ascertained to be carbonic acid by the instantaneous change of form which it undergoes between 30° and 31° C., which is characteristic of that substance. Now, carbonic acid can not be liquefied except under a pressure which exists in nature only deep in the earth. Hence the meteorites must have been at some time subjected to such a pressure. It is therefore concluded that they have come from the interior of some planetary body which has been rent by an explosion.

Proceedings of the Boston Society of Natural History, Vol. XXIV, contains the reports of the society and its proceedings, with the papers read, from May, 1888, to May, 1889. Prof. Hyatt's report as curator of the museum shows that that institution is growing at a healthy rate, and the arrangement of its collections is going forward. The papers relate to various topics of biology, geology,

and archæology. Among them are those of Prof. Hyatt on the "Evolution of the Fauna of the Lower Lias"; of Mr. S. H. Scudder on a Palæozoic "Cockroach Fauna" at Richmond, Ohio; of Prof. Marcou on "Canadian Geological Classification for the Province of Quebec"; of Mr. Alfred C. Lane on the "Geology of Nahant"; of Mr. Warren Upham on "Marine Shells and Fragments of Shells in the Till near Boston"; of Mr. Samuel Garman on the "Evolution of the Rattlesnake"; and of Prof. Goodall on the "Life and Work of Dr. Asa Gray."

Several archæological papers, which appear in this volume of the "Proceedings," are also published separately by the Peabody Museum of American Archæology and Ethnology, under the title of *Palæolithic Man in Eastern and Central America*. They are "Early Man in the Delaware Valley," including an account of the lately discovered "Rock Shelter" at Naaman's Creek, and descriptions of Palæolithic implements; and an account of an implement from the Indiana gravel, by Hilborne T. Cresson; Prof. G. F. Wright's paper on the "Age of the Philadelphia Red Gravel"; "Water-worn Implements from the Delaware River," by Dr. C. C. Abbott; and remarks on the whole subject by President F. W. Putnam. Prof. Wright's paper bears upon the age of the rock shelter and of the implements in the Delaware Valley described by Mr. Cresson, which the author decides are older (perhaps by a thousand years) than the deposits at Trenton, N. J., Loveland and Madisonville, Ohio, Little Falls, Minn., and Medora, Ind. (Cresson).

An Obsidian Implement from Pleistocene Deposits in Nevada, by *W J McGee*, discusses the age of a handsome neolithic work found on Walker River, to which the author has already made reference in the "Monthly" (November, 1888, p. 25). The solution of the question is partly dependent upon the character of the occurrence of the implement—whether it be adventitious or normally *in situ*. The deposit being unconsolidated, this can not be determined certainly without the help of other human relics found in the same place to keep it company; and such have not been found. But, since the implement was observed, the discovery of other extremely ancient relics in various parts of the country has given color to the hypothesis that this was an original deposit; and the author now inclines to that view.

The Aborigines of the District of Columbia and the Lower Potomac—a symposium in the Anthropological Society of Washington—besides an address by Otis T. Mason, introducing the subject, contains papers on "The Geological Antecedents of Man in the Potomac Valley," by W J McGee; "The Palæolithic Period in the District of Columbia," by Thomas Wilson; "Ancient Village Sites and Aboriginal Workshops," by S. V. Proudfitt; "The Pottery and Textiles of the Tide-Water Region," by W. H. Holmes; "The Shell Mounds of the Potomac and Micomico," by Elmer R. Reynolds; "Indian Tribes of the District," by James Mooney; and a discussion by Prof. F. W. Putnam.

Of six additional "Bulletins" of the United States Geological Survey, No. 48 is *On the Form and Position of the Sea-Level*, with special reference to its dependence on superficial masses symmetrically disposed about a normal to the earth's surface, by *Robert Simpson Woodward*. The treatise is mathematical, and relates to a problem of peculiar difficulty, the solution of which has been as yet only approached. The same author's *Latitudes and Longitudes of Certain Points in Missouri, Kansas, and New Mexico*, constituting "Bulletin No. 49," relates to the processes of determination at Oswego, Elk Falls, and Fort Scott, Kan.; Springfield and Bolivar, Mo.; and Albuquerque, N. M. The author has endeavored to collect, arrange, and discuss the observations in such a manner as to render their results most useful for the purposes of geography and geodesy. Bulletin No. 50, also by Mr. Woodward, consists of *Formulas and Tables to facilitate the Construction of Maps*. The tables were prepared for the Division of Geography in 1885–'86. Constant use since then has demonstrated their utility. They have been revised and extended, and are accompanied by an explanatory text. Dr. *Charles A. White* gives, in Bulletin No. 51, descriptions of some *Invertebrate Fossils from the Pacific Coast*. They fall under five headings: "New Mollusca from the Chico-Tejon Series of California," representing nineteen new species and one new genus; "The Occurrence of Equivalents of the Chico-Tejon Series in Oregon

and Washington Territory"; "Cretaceous Fossils from Vancouver Island Region," in which an intimate relation is shown with the fauna of the Chico group; "The Molluscan Fauna of the Puget Group," unique and indicating deposition in a large estuary; and "Mesozoic Mollusca from the Southern Coast of the Alaskan Peninsula," which are regarded as new. No. 52, *Subaërial Decay of Rocks and Origin of the Red Color of Certain Formations*, relates studies of the subject by *Israel Clark Russell*, chiefly among the Appalachian Mountains in Virginia and North Carolina. The author believes that changes by decay have a wider geological bearing than has generally been assigned to them; and that the red color of certain sandstones is due to a coating of their particles with ferric oxide received during the process of subaërial decay of the rocks of the *débris* of which they are composed. The last of the present series of Bulletins—No. 53—is a study of *The Geology of Nantucket*, by Prof. *N. S. Shaler*. The island is regarded, together with the accompanying southern Massachusetts coast, Martha's Vineyard, Long Island, etc., as "the dissevered remains of a great shelf formed of the *débris* brought to its present position by the glacial ice and by the streams of water which flowed beneath it."

The United States Department of Agriculture, Division of Entomology, publishes an investigation of *The Root-knot Disease of the Peach, Orange, and other Plants in Florida, due to the Work of Anguillula*, made under its direction, in 1888, by Dr. *J. C. Neal*. A large number of species of plants are attacked by the worms, whose depredations are marked by the appearance of swellings or "knots" on the roots, and threaten to be damaging. The author has made studies of the nature of the insect and its ravages, and has experimented with reference to the remedies. His report is illustrated with plates representing attacked roots and the life-history of the enemy.

The June number of the *Journal of Morphology*, Vol. III, No. 1 (Prof. *C. O. Whitman* and *Edward Phelps Allis, Jr.*, editors; Ginn & Co.), contains articles on "The Actiniaria of the Bahama Islands," by Dr. J. Playfair McMurrich; "Contributions to the Comparative Osteology of the Families of North American Passeres," and "Notes on the Anatomy of *Speotyto cunicularia hypogea*," by Dr. R. W. Shufeldt; and "Variation of the Spinal Nerves in the Caudal Region of the Domestic Pigeon," by James I. Peck. The September number, Vol. III, No. 2, has "The Mechanical Causes of the Development of the Hard Parts of the Mammalia," by E. D. Cope; and "The Embryology of *Blatta germanica* and *Doryphora decemlineata*"—the cockroach and the Colorado potato beetle—by William M. Wheeler.

A Bibliography of Geodesy was compiled by Prof. *J. Howard Gore* to supply a need which he felt while preparing a work on the "History of Geodesy." Before proceeding far in that work he found it very difficult at any time to make sure that the literature regarding the operations of a given period had been exhausted, and he sought to collect titles as well as the works themselves. His purpose extended to making the enterprise useful to others. He went abroad and searched through European libraries, examined minor libraries by proxy, and corresponded with authors to find if they had any other works than those of which he had the titles. The outcome of this persevering labor is a list filling four hundred columns of references, with short remarks where the title alone is not explanatory enough. Several institutions, among them the International Geodetic Congress of Berlin, offered to publish the book; but the author thought our Coast and Geodetic Survey was entitled to the preference, and the work is therefore issued under its auspices.

Part I of the nineteenth volume of the "Annals of the Observatory of Harvard College" contains *Meteorological Observations made during the Years 1840 to 1888 inclusive*, under the direction of the several directors of the observatory, Profs. *W. C.* and *G. P. Bond*, *Joseph Winlock*, and *E. C. Pickering*. Partial publications of these observations could already be found in the "Memoirs" of the American Academy of Arts and Sciences, the "American Almanac," and the Patent-Office Reports, but it has seemed desirable to make a collection of the monthly means. The volume begins with a history of the meteorological work of the observatory; the "monthly and annual results" come next; after which follow "Observa-

tions of Aurora Borealis," "Thunder and Lightning," and "Miscellaneous Phenomena," embracing "temperatures of wells," of "river, rain, and cellar," "Extremes of Atmospheric Pressure or Temperature," "Solar Halos and Parhelia," lunar halos, and "General Remarks."—Vol. XX, Part II, of the same series records the *Observations made at the Blue Hill Meteorological Observatory*, Massachusetts, in 1888, with a statement of the local weather predictions, under the direction of *A. Lawrence Rotch*.

A paper on *Domestic Economy in Public Education*, by Mrs. *Ellen H. Richards*, of the Massachusetts Institute of Technology, is published in the series of "Educational Monographs" of the New York College for the Training of Teachers. The success of the manual training system that has been developed out of the carpentry classes for boys has prompted the author to look for a kindred course adapted to the life of girls. She finds it in domestic economy, in which the purposes of sanitary science and hygiene should play an important part. A schedule for a four years' course is introduced. In it cooking—"kitchen science"—is prominent, and this, the author insists, can be placed on a level with the use of workshop tools as a means of mental and physical training. Having mentioned the scientific principles involved in the processes of preparing a meal, the author maintains that "the school-girl who has had the elements of chemistry and physics, which are often taught as abstract sciences, summed up and applied to the making of a simple dish, has had her mind awakened to the relations and interdependence of things as no other training now given can awaken it." In an appendix are given summaries of the provisions made for teaching domestic economy in several public schools and colleges in the United States and in the girls' schools of the city of Paris.—Another number of the same series is an essay on *Graphic Methods in Teaching*, by *Charles Barnard*, with an introduction by Prof. *John F. Woodhull*, setting forth "Training in Natural Science as an Essential Factor in the Education of the Citizen." Mr. Barnard's essay embodies the relation of experiences in training children to the observation of natural facts and phenomena, and to keeping regular records of them by means of the graphic system, with specimens of the actual work of certain children in that line. Of the value to the child of thus recording weather observations the author says: "The making of the diagram (printed forms should never be used) is something in the way of mechanical drawing that is a good training for the hand and eye. Secondly, the diagram, being fastened upon the wall in some convenient place, becomes a reminder of stated work to be done at a fixed hour—a capital training in punctuality, promptness, and precision." Then the thermometer is a tool which the child learns to use. He is induced to go out of doors. Pride is taken in the work as it goes on, developing a regular course. It is instructive and a useful exercise in neatness and accuracy, and when it is done "the child has two graphic statements of real phenomena in nature observed by himself and so recorded that at the end the entire work of the month is plainly seen."

The Globe, a New Quarterly Review of World-Literature, Society, Religion, Art, and Politics, of which we have the first number, October to December, 1889, is projected by *William Henry Thorne*, in Chicago, to be a "first-class literary review," which he believes we have not; and he aspires "to edit and publish something better, broader, stronger, and more cosmopolitan" than any existing American periodical. After a careful inspection of his work we are forced to say with regret that he has not reached the object of his aspiration, and that the want he describes, if it existed before, is still unsupplied. The initial number of *The Globe* contains articles on "The Fuss about Bruno," "The English, French, and American Stage," "The Heroic and Commonplace in Art," "Emerson and his Biographers," "Socialism and Poetic Retribution," "Dr. McCosh and Modern Philosophy," etc.

Edenic Diet, the Philosophy of Eating for the Physical and Mental Man (Isaac B. Rumford, Santa Cruz, Cal., 25 cents), is intended primarily to exalt an exclusive vegetable diet and furnish recipes involving its principles. To this are added a mass of rhapsodical matter and a scheme for "an Edenic home" which those may enjoy to whose mode of thought they are adapted.

Mr. J. Madison Cutts, of Washington,

has published, as especially pertinent to the times, an address by the late *Stephen A. Douglas* on *An American Continental Commercial Union or Alliance.* It is, he says, the last paper written by the distinguished statesman, and has not been published before. It was prepared after seven of the Southern States had gone through the form of seceding, and was intended to serve as one of Mr. Douglas's immediate plans to promote the future welfare of the country in case a reconciliation and restoration were effected. Besides its interest as the last thought of one of the most distinguished statesmen of the period before the war, the address is pertinent on account of its direct bearing on a scheme of national policy which is now under discussion.

In an essay on *God and the Universe*, Mr. *James W. Stillman* proposes to consider "the alleged existence of a Supreme Being and the theistic hypothesis of creation." He is brought to the conclusion that "the whole problem of the existence of God and the origin of the universe is entirely beyond and above the scope of the human intellect"; and there he is content to leave the matter.

In a pamphlet on *The Disposal of the Dead*, Dr. *John M. Peacocke*, of Brooklyn, after considering other methods, suggests desiccation, which was practiced by the ancient Peruvians, as in many respects the preferable one.

Questions for Debate in politics and economics is the latest publication (No. XXVIII) of the Society for Political Education, 330 Pearl Street, New York. A perusal of its pages shows its compilers to have seized upon every living issue affecting American citizenship. In addition to the questions, subjects for essays are given, as well as terms for definition. Brief and pithy hints to debaters and essay-writers are included, as also a form of constitution and by-laws for debating-clubs. Pages 40. Price, 25 cents.

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POPULAR MISCELLANY.

Flour-making in the Northwest.—Mr. Charles A. Pillsbury, of Minneapolis, states that the manufacture of flour is to-day probably the largest industry in the United States, not excepting that of iron. About 85,000,000 barrels of flour, of an average value of about $400,000,000, are made in this country yearly. About ten per cent of this product is manufactured in Minneapolis. As much as 1,000 car-loads of wheat are often received at Minneapolis in a single day, or enough to load a train six miles long. To say that flour made from Minnesota and Dakota wheat is the best in the world is only saying what is recognized by the trade the

world over, in the prices which it brings as compared with other flours. Wheat grown in this latitude has so large a proportion of gluten and phosphates that it is gradually but surely crowding more starchy flours to the wall. When Mr. Pillsbury began milling twenty years ago, he secretly brought flour from St. Louis to use in his own family. Minneapolis flour sold very much below that made in other sections of this country, and stood at the foot of the list in market quotations. Now it stands at the top of the list. A Board of Trade report, of the city of Minneapolis, for 1866, stated that the production of flour in the city during that year was 172,000 barrels; now it is forty times as much. Only eleven years ago the amount of flour made in Minneapolis and exported from this country was 109,183 barrels; now it is over 3,000,000, or thirty times as much. It is the improvement which has been made in milling in this section which has accomplished these results. It has also made the rapid settlement of the Northwest possible, as wheat is by all odds the chief crop of that region. On the other hand, the rapid increase of the farming population in the tributary country has made possible the rapid increase of mills in Minneapolis. Another thing that has contributed largely to this result is cheap transportation to the East. A few years ago the millers were paying one dollar and a half a barrel to get their flour carried to the seaboard; now the rate is only fifty-five cents. Mr. Pillsbury deems it quite possible that the flour industry of the Northwest is even yet in its infancy, as probably not more than ten per cent of the available land tributary to Minneapolis has been placed under cultivation.

Aboriginal Mounds in Manitoba.—The Winnipeg mound region, as described in the American Association, by Prof. George Byles, of Manitoba College, includes a district some four hundred miles long from east to west, and running from the international boundary north to at least latitude 50°. The author had seen some sixty mounds and had opened ten, working usually in connection with the Manitoba Historical Society. Numerous skeletons have been exhumed. Unmanufactured articles found included large quantities of charcoal—red and yellow ochre and birch bark charred. Manufactured articles: Stone implements, scrapers, gouges, chisels, axes, malls, conjurers' tubes, and a set of gaming stones. Bones: Breast ornaments of various kinds, whistles, beads, etc. Shells: Columella of conch from trophies, tropical natica and marginetta shells made into beads, wampum, and breast ornaments. Horn: Fish-spear, pottery, numerous marked fragments, various copper implements, and near one skeleton two lumps of arsenical pyrites, no doubt used as sacred objects. All mounds were circular, and all on prominent headlands. The majority contained skeletons, probably of Mandans of the Missouri, who fifty years ago were almost exterminated by small-pox. Certain mounds, from the state of the bones and certain topographical and geological considerations, are likely to date from the beginning of their central parts four hundred years back.

Tapestries.—The word tapestry has primary reference to carpets. As now used, we learn from a lecture by Mr. Alan S. Cole upon the subject, it may be read in two senses: one in which it refers to hangings generally; and the other in which it implies a special method of producing a textile fabric. In making carpet by hand, as in ordinary weaving, a stretched warp is necessary; but the warp-threads play no visible part in the face of the carpet. They are covered with weft-threads. Instead of a shuttle with a weft, as in weaving, various sets of thread are used, which are looped, knotted, and intertwined upon the warp-threads. In making carpets with a pile, the ends of the threads which have been knotted upon the warp are cut. From above these knotted threads, and across and in between the warp-threads, a stout thread is thrown. This is pressed down with a comb, so as to compact the whole fabric. A fresh series of knottings is then made, and the previous operations are repeated. In another closely allied process for making carpets and hangings, a stout cord is thrown across and in between the warp-threads; no scissors are used to cut the ends of knotted warp-threads, and no pile is produced. This process requires the variously colored wefts to be intertwisted between groups of the warp-

threads; and in this respect it is almost identical with that particular process which is known as tapestry-making; but tapestries are finished for display on one side only. They are made upon vertical threads, when they are high-warp or *haute lisse*, or upon horizontal threads, when they are low-warp or *basse lisse*, tapestries. But the results of both methods are virtually identical, so that it is almost impossible to detect any peculiarity which shall distinguish one from the other. The earlier hangings appear to have been of lighter material than that of the special fabric; and they were ornamented by weaving, embroidery, or painting. The special process was applied in early times to making small ornamental trimmings for costume. Its application to works on a much larger scale appears to date from the twelfth and thirteenth centuries, although it had probably been already employed in old Asiatic civilizations for carpets. The number of colors of the earlier tapestries was restricted, but, after the tapestry-making craft was established, a more generous scheme of colors was employed. This has developed in such a way that it is a boast now at the Gobelins factory that they have upward of fourteen thousand four hundred tons of colors in dyes for threads.

Our Arid Regions and the Rainfall.—The soils of the arid regions of the United States, according to the paper read by Prof. J. R. Dodge at the meeting of the American Association, are generally fertile to excess. The only amelioration they require is that which is secured by the application of water. That may be obtained from natural precipitation; by irrigation from supplies at present available or from storage reservoirs and catch-basins to be erected to hold the surplus of rains; by pumping from the underground channels of streams; or by means of artesian wells. After all available water has been obtained by these means and expedients, there is still a large part of the superficial area that must remain unirrigated. Some say that this part constitutes four fifths or five sixths of the whole, but those who have an intimate knowledge of the practical work of irrigation insist that it is not more than one tenth or one eighth of the area. Still, the remainder is not quite a desert. There are what are called agricultural rain-belts which, with from fifteen to eighteen inches of water, sometimes twenty inches per annum, are found to produce good crops of corn up to an elevation of three thousand or four thousand feet, and wheat, oats, potatoes, alfalfa, and many grasses up to six thousand or seven thousand feet, by adaptation of methods of cultivation to suit the best utilization of available moisture. The question of increasing rainfall gains an affirmative answer from practical cultivators, while the records of the rain-gauge fail to make such a response. There is an increase, if not in actual rain, certainly in available moisture; for the water which formerly flowed away with as much facility as from the back of a duck, is nearly all retained by cultivated lands. If the irrigation is general and continued for years, there is a change of climate, with more moisture in the atmosphere, dews at night frequent where they were formerly unknown, and general enhancement of the agricultural value of the air.

The Beauty of Childhood.—A recent discovery of classical sculptures has recalled attention to the fact that the ancients had, so far as appears from their works, no appreciation of the beauty of childhood. In the present instance, in which the figures relate to death scenes and include family pictures, while the mature characters are represented with the best skill which the artist could command, the children—at the age fullest of beauty for a modern eye—are executed with archaic clumsiness. Miss Harrison has pointed out, in her lectures on Greek sculpture, that representations of infancy are characteristic of the decaying art of Alexandria; the best period of art affords no specimen of such a choice of subject. "The artists whose work has afforded models for all time have not left a single specimen of that beauty which modern eyes most admire, the beauty of childhood." And in Grecian and Roman literature there is none of that happy picturing, that dwelling with delight upon the beauties of childhood that seem to have entered into the very essence of modern natures. To the Romans, "infancy was only a journey toward manhood; the sooner it was over the better." In the reference to childhood which is most truly

affecting of all in ancient literature, the fright of the child in Homer's "Parting of Hector and Andromache," the interest, "if we analyze it, belongs rather to an impartial delineation of human life as it is, than to any sympathy with the helplessness and dependence of its earliest stage." While modern art does not show an equal lack of the taste for childhood, it "is comparatively feeble at all times in comparison with the feeling of our own day." This feeling is reflected in its intensity first in the poems of Wordsworth and the pictures of Sir Joshua Reynolds. "This sympathy with childhood," says the writer in the "Spectator" whose essay we have summarized, "which gives its coloring to modern literature and art, is to be traced back to utterances which have influenced more than the literature and art of modern Europe. 'Except ye become as little children, ye can not enter into the kingdom of heaven,' was a saying new to the world. The fresh aspect under which all weakness, all dependence, appeared in the light of that teaching, was evidently bewildering to its hearers." It took centuries for the Christian world to take in the full meaning of that utterance, which has not been realized as a fact of ordinary life till nearly our own time. But now, "for a year or two in this pilgrimage of ours, the most commonplace, the most tiresome of us is invested with this wonderful capacity [of persuasion and conciliation]; every human being has once upon a time hushed enmities and bridged estrangement."

Iron as a Purifier of Water.—The power of iron to remove coloring matter and organic contamination from impure waters has been made capable, by recent improvements in processes, of receiving a greatly extended application. In Prof. Bischof's system, a sand filter which separates the mechanical impurities is underlaid by a mixture of gravel and iron in the proportion of three parts to one. When the water is drawn off from this filter after using, no discoloration is visible in the upper sand, nor till near the iron mixture. In this the particles of gravel and iron become thickly coated and mixed with the reddish, slimy product of the chemical action of the iron; and, still lower down, the mixture is black, and not subject to change. The slimy-coated mixture has to be removed and washed every six months. By another improvement the iron is presented in a state of constant agitation, and the slimy coating being washed away as fast as it is formed, an always clean surface is offered to the water. The working of the method is satisfactory, and may, by adding fresh iron from time to time, be made nearly continuous. The purification depends upon the chemical action of iron on organic matter in solution, and its property of coagulating very finely divided particles of matter so that they can be removed by filtration. The iron, in this process, changes the chemical nature of the organic matter and greatly reduces the albuminoid ammonia; softens the hard scales that form in boilers, and destroys or removes much of the infusorial life in the water.

A Bit of Triassic History.—Mr. W. M. Davis's study of the "Topographic Development of the Triassic Formation of the Connecticut Valley" shows that the country from northwest to southeast suffered from repeated faultings after the trap sheets had taken their places, as extensive surface-flows, in the stratified series, the trend of the faults being to the southwest. The initial constructional regions are represented by the faulted blocks of southern Idaho. A mountainous variety of form prevailed—which may provisionally be called the Jurassic stage of the evolution of the district; but in time—during the Cretaceous—the faulted ridges were reduced to a low, base-leveled plain, in which the present valleys were worn after its elevation. The Connecticut River was originally consequent on the monoclinal faulting; and, while it has entered on a second cycle of life as a result of the elevation of the lowland that was produced in its first cycle, it still persists in the course it first took.

Uranium.—It is now a hundred years since Klaproth (in 1789) discovered the metal which he named after the planet Uranus, then recently discovered by Herschel. Uranic oxide, which is yellow, is used to produce a beautiful golden color, and, with other minerals, opalescent tints in glass and porcelain. The pentoxide is black, and is used in the production of

costly black porcelain and the dark tints in majolica-ware. The chloride of uranium is coming into use as a substitute for the chloride of gold in photography. It is anticipated that two extensive fields for the employment of the metal will soon be opened. One is as a substitute for gold in electro-plated ware, for with platinum and copper it forms two beautiful yellow alloys. Its platinum alloy has a special value from its power of resistance to the action of acids. The other use will be found in electric installations, and depends on its high electrical resistance. Uranium has hitherto been found only in pockets or patches in Bohemia, Saxony, and Cornwall, but in the centennial year of its discovery a lode of the metal which promises a large supply was found in the latter region.

A Chemist's Services to Mankind.—In a recent address on the life-work of Pasteur, Sir Henry E. Roscoe emphasized the benefits to humanity which have resulted from the researches of the great French chemist. "The first and obvious endeavor of every cultivator of science," he said, "ought to be to render service of this kind. For, although it is foolish and short-sighted to decry the pursuit of any form of scientific study because it may be as yet far removed from practical application to the wants of man, and although such studies may be of great value as an incentive to intellectual activity, yet the statement is so evident as to almost amount to a truism, that discoveries which give us the power of rescuing a population from starvation, or which tend to diminish the ills that flesh, whether of man or beast, is heir to, must deservedly attract more attention and create a more general interest than others having so far no direct bearing on the welfare of the race." Pasteur's series of valuable labors, including the discovery of the causes and remedies for the sicknesses which wine and beer undergo, the cure of the silk-worm disease, the existence of which in one year cost France more than one hundred millions of francs, the extermination of fowl-cholera, and of the fatal disease known as anthrax in cattle and wool-sorters' disease in man, culminates in his discovery of a successful treatment for rabies. Prof. Roscoe gives an idea of the wide demand for the treatment of Pasteur's laboratory in these words: "There I saw the French peasant and the Russian *moujik* (suffering from the terrible bites of rabid wolves), the swarthy Arab, the English policeman, with women too and children of every age, in all perhaps a hundred patients. All were there undergoing the careful and kindly treatment which was to insure them against a horrible death. Such a sight will not be easily forgotten. By degrees this wonderful cure for so deadly a disease attracted the attention of men of science throughout the civilized world. The French nation raised a monument to the discoverer better than any statue, in the shape of the 'Pasteur Institute'—an institution devoted to carrying out in practice this anti-rabic treatment, with laboratories and every other convenience for extending by research our knowledge of the preventive treatment of infectious disease." The contrast between the spirit of science and the spirit of war is well expressed in Pasteur's own words at the opening of this institute: "Two adverse laws seem to me now in contest. One law of blood and death, opening out each day new modes of destruction, forces nations to be always ready for the battle-field. The other, a law of peace, of work, of safety, whose only study is to deliver man from the calamities which beset him."

The Cotton Fiber.—Mr. Thomas Pray, Jr., in a lecture before the Franklin Institute, said that the ordinary way of judging raw cotton by feeling with the fingers was exceedingly crude, seeing that the fibers vary all the way from $\frac{1}{300}$ of an inch in thickness for the coarsest "upland," to $\frac{1}{1000}$ for the best Sea Island cotton. Some few cotton-spinners have now been induced by Mr. Pray to adopt the microscope in examining cotton. The finest cotton raised in any of the fields of the world comes from the Mississippi delta. Under the microscope it is seen to be beautiful in structure, of perfect development, full of oil deposits, and having nearly four hundred spirals per inch. It makes very strong yarn, capable of coloring all the delicate shades, like pink, and bleaches in the most perfect manner. Dyers frequently find spots in cotton goods that will not take color at all, or only unevenly. Cer-

tain pieces can not be printed or colored anything but black. If fibers of such cotton are looked at under the microscope after being mordanted, some parts will be seen prepared for coloring, and others where the mordant has not taken hold. Cotton is often badly damaged by poor ginning; the fibers are torn, and millions of short pieces to every bale are broken off, which in spinning fly all over the mill and machinery, and go into the waste instead of being made into yarn. Much has been said about "parallelism" of cotton fibers in the manufactured goods, but, if a bit of one of the best grades of cotton cloth made is examined under the microscope, there is seen to be no such thing as parallelism among the fibers.

Snow-Blindness.—Snow-blindness, according to Dr. Berlin, of Nordenskiöld's Expedition to Greenland of 1883, is met with as far north as any arctic expedition has penetrated, but is unknown, except sporadically in high mountains, south of certain degrees of latitude. It follows the sinuosities of the isothermal lines. In the arctic regions it breaks out usually in the spring-time, but also occurs in summer wherever snow remains. It appears during snow-storms and fogs, as well as when the sun is shining. The prominent symptom is an intense burning pain in the eyes, beginning with a prickling sensation as if produced by a foreign body, with increased secretion of tears, photophobia, and blepharospasm. The visual power is not diminished, but the field is narrowed. Most cases will get well at the end of two or three days, if the patient guards himself against the exciting causes; or the disease may, exceptionally, become a serious matter. It is not a dazzling caused by the snow, for dazzling does not produce its effects, and it does not prevail everywhere that there are snow and sunlight; nor can it be explained by the fact of the rarefaction of the air. It is probably a result of the low temperature and the want of humidity in the air which characterize the places where it prevails. As it is the humidity of the air which principally absorbs the radiant heat, the caloric rays of the sun must, in those localities, manifest an intensity of action far above the common. Observation has shown that this is the case, for on high mountains and in the arctic regions exposure to the sun's rays produces on the bare skin an excessively painful dermatitis, which the radiant heat reflected by the snow very much aggravates. The effects of exposure to the sun appear to be most severe in spring-time. The eyes are affected simultaneously with the skin or somewhat previously. The ordinary treatment of snow-blindness consists in the use of spectacles of dark-colored glass, with opiates to relieve the pain. Blackening of the nose has been found by several travelers to be an effective remedy.

The Great Hall of the Mammoth Cave.—Some important new discoveries in the Mammoth Cave were described by the Rev. Dr. H. C. Hovey at the meeting of the American Association. They are connected with the arrangement of the cave passages in tiers and the great pits or domes. Following the guide across a treacherous chasm known as the covered pit, the author found a series of these chasms exceeding in size any that had ever been discovered before. He afterward visited the pits with a photographer, Mr. Ben Hains, and means for taking photographs. As measured from above, they varied from forty-seven to one hundred and thirty-five feet in depth. With much difficulty and risk he succeeded in reaching the bottom of Charybdis, the deepest of the pits, and there discovered, by the aid of chemical fires, that the whole series of pits, eight in all, were joined at the bottom into one magnificent hall several hundred feet long. This hall was traversed from end to end. Dr. Hovey proposes to name it Harrison's Hall, after the President of the United States.

NOTES.

A BACTERIAL disease of carnations was described by Prof. J. C. Arthur at the meeting of the American Association. It is revealed by the presence in the leaves of transparent dots that can be seen only by transmitted light. These spots increase and coalesce, and finally kill the tissues, when the leaves dry up and the plant gradually dies. The transparent spots are found, under the microscope, to be due to the enlargement of the cells with bacteria.

WHEN the governor of a province in Madagascar wishes to issue a proclamation,

he sends out, according to Mr. L. H. Ransome, messengers to all the villages under his control, bidding the principal men from each to assemble at an appointed time; this gathering is called a *kabary*. When all those summoned are present, the governor or his deputy reads aloud the proclamation, which then becomes law, the representatives of each village being responsible for its publicity. Sometimes justice is administered at a *kabary* of this kind, when the governor pronounces sentence, after hearing the evidence on both sides.

A METHOD of sewage purification called the "Amines" process is being tried at Wimbledon (England) Sewage Farm. It is so named because it employs certain basic carbon compounds called *amines*, together with milk of lime. At present herring-brine is the cheapest substance which contains the amines. When the brine is introduced into freshly made milk of lime it is decomposed and a very soluble reagent is evolved, to which the inventor has given the name "aminol." This substance has a peculiar briny odor, and when introduced into sewage is said to extirpate all micro-organisms capable of causing putrefaction and disease.

A COMMITTEE of the Royal Society has been appointed on the erection of a national memorial to Dr. Joule.

A SPECIMEN of the crested starling (*Fregilupus varius*), of Réunion Island, has recently been obtained for the British Museum. This bird, which has been probably exterminated, is rarer in collections than the great auk. Its coloring consists simply of black, white, and gray, but when alive it must have been a graceful bird. Some creoles on the islands, who remembered the bird in their younger days, told the late Mr. Pollen that it was so tame and stupid that it could be knocked over with a stick. Only sixteen specimens are known to exist, and there is none in any American museum.

CONCERNING "the grass problem in Nebraska," Prof. Bessey, at the agricultural meeting of the American Association, mentioned places where buffalo grass is plentiful, and others where the soil is a moving sand, that gradually becomes covered with native American grasses. In older tracts, timothy has been introduced, Kentucky blue grass is grown successfully, and clovers are doing well. Prof. Beal, in a paper on "Wild Grasses under Cultivation," said that he had found in his researches many wild grasses that were valuable, and advised selections for experiment.

PROF. FERNOW is quoted in the "Toronto Globe" as advancing, in an interview, the opinion, respecting the influence of forests on climate, that the lack of moisture on the plains of a large portion of the West was due not so much to deficient rainfall as to excessive evaporation, which in turn was due to the unchecked action of the wind. Were there wind-breaks in the form of patches of trees in that country, part of the land would be thereby reclaimed, and the reclamation of the rest would be rendered far more easy. The proposition of Major Powell, to remove the forests from the crown of the Rocky Mountains, as a means of improving the water conditions of the desert, he regarded as preposterous, and opposed to all our knowledge regarding the natural conditions of mountainous districts.

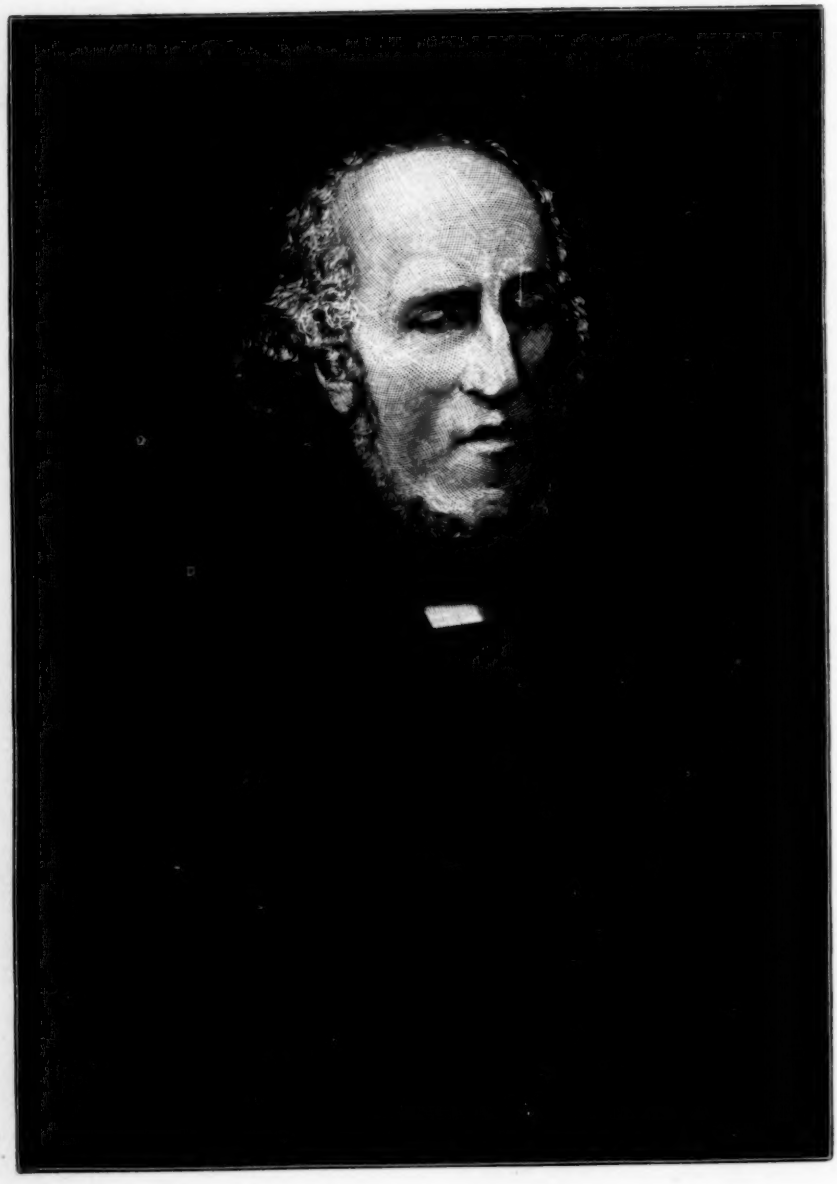
DR. VON REUBEN PASCHNITZ having concluded that when earthquake-shocks occur simultaneously at different places, as recently happened in Japan and Germany, a connection may be presumed between them, Mr. William White has presented some very forcible arguments in "Nature" in support of an opposite view.

A STATUE of the French chemist, Nicolas Leblanc, has been erected at Saint-Denis, where he had a manufactory.

WHILE the enormous output of coal during the last few years has not actually crippled British fuel resources, Prof. Hull anticipates a general rise in the value of coal in the near future, on account of the great depth at which the mines will have to be worked, and the increased cost of coal-mining.

BOTH the Russian and English engineers are planting trees extensively as an aid to their operations in Central Asia. The Russians, under the direction of General Annenkoff, are especially active in this work. Orders have been given that no bushes are to be cut down within ten miles of the Transcaspian Railway, and that the existing forests of saxaul are to be preserved. Plantations of this, which is a kind of brier-wood, are to be made along the line, with camel-thorn and other native bushes that thrive well. It is expected that these will protect the line and provide shelter for weaker trees and bushes of foreign origin. The tree-planting of the last three years has not been a complete success, but experience has shown what varieties will and what will not thrive.

THE London "Spectator" publishes letters showing that the idea that horse-hairs dropped into water in time beget life and become worms or "snakes" prevails extensively over Europe as well as America. It is based on the fact that worms resembling short horse-hairs exist, and are not uncommon in placid pools. A contributor to the "Spectator" accounts for the experiences of persons who claim to have "seen" the horse-hairs become living, by observing that after lying in the water for a long time a hair swells, assumes the form of a young eel, and, in a way common to many inanimate substances, acquires a slow, wriggling motion.



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